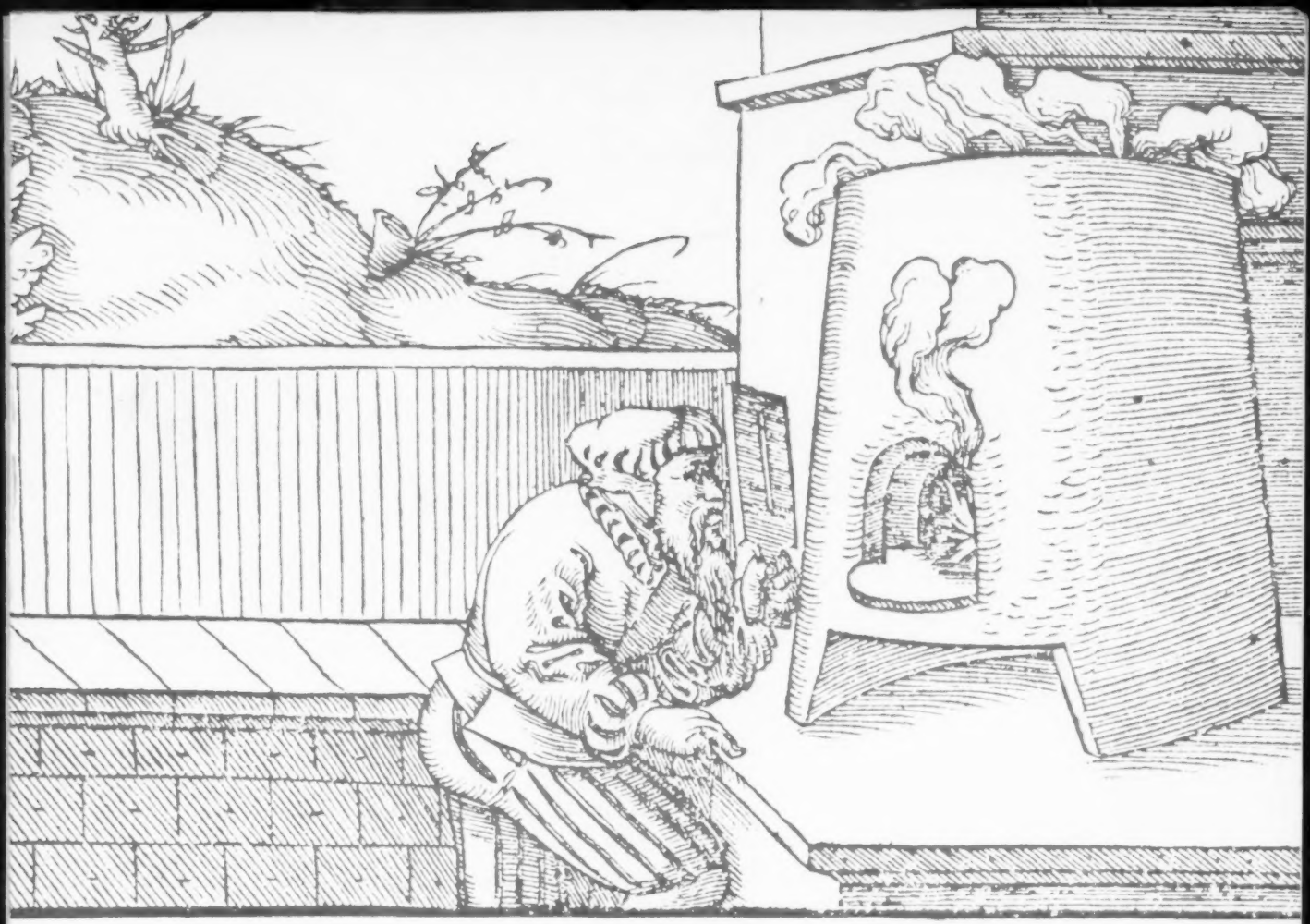


Alchemy:
Forerunner of Modern Chemistry

the Cornell engineer

COLLEGE OF ENGINEERING — CORNELL UNIVERSITY

OCTOBER, 1958 — VOL. 24, NO. 1 — 25 CENTS

Design a 2-lane steel bridge to cross a modern highway—

$44,000 in cash awards!

American Bridge Division of United States Steel announces a $44,000 STEEL HIGHWAY BRIDGE DESIGN COMPETITION dedicated to stimulating the engineering mind to a more imaginative, more effective use of steel in the construction of small bridges.

If you, as a professional or design engineer or as a college engineering student, can come up with a more imaginative, attractive and economical design, not only may you win up to $15,000 in award money, but your efforts may contribute materially to the most challenging road-building program ever undertaken. For, according to conservative estimates, the tremendous 41,000-mile Federal Highway Program will call for the construction of at least a bridge a mile!

The competition involves solving a relatively simple but important problem that will not demand too much of your time.

Awards for College Engineering Students

	each
1st Award	$4,000.00
1st Honorable Mention	$2,000.00
2nd Honorable Mention	$1,000.00
Four 3rd Honorable Mentions	$ 500.00

Awards for Professional Engineers

	each
1st Award	$15,000.00
1st Honorable Mention	$10,000.00
2nd Honorable Mention	$ 5,000.00
Five 3rd Honorable Mentions	$ 1,000.00

Problem: Get two lanes of traffic across a modern 4-lane highway in accordance with latest standards for today's highways.

Objectives: Originality of design, greater utilization of the inherent properties of steel, economy, and aesthetic appeal.

Requirements: Just one. The steel bridge must comply with the Geometric Standards for the National System of Interstate and Defense Highways using H-20-816-44 loading. The type of structure, the type of connections, span length and number of piers, if any, are completely up to you since you are designing with steel.

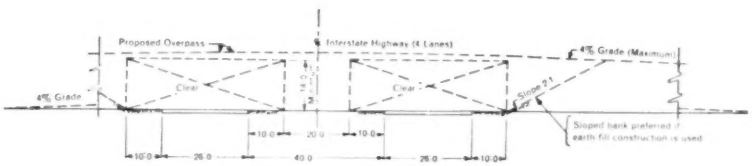
Eligibility: The competition is open to all professional and design engineers and college engineering students except employees and/or members, and their immediate families, of the following firms and groups:

United States Steel and its subsidiaries, divisions, agents and dealers
Structural steel fabricating firms
American Institute of Steel Construction
Rules Committee and Judges

See list of awards above.

Rules and Judging: The competition will be under the supervision of the American Institute of Steel Construction, which has appointed a Rules Committee and a panel of judges composed of prominent consulting engineers and architects.

Deadline: Entries must be postmarked or expressed to arrive not later than midnight, May 31, 1959. *USS is a registered trademark*



ELEVATION and CLEARANCE DIAGRAM

Send for your entry booklet now: Contains complete information on the Steel Highway Bridge Design Competition—everything you need to know to prepare your entry. Just fill in and mail the coupon and get started with your design without delay.

United States Steel

Competition Editor, Room 1831
American Bridge Division
525 William Penn Place
Pittsburgh, Pennsylvania

Please send me a copy of your $44,000 Steel Highway Bridge Design Competition entry booklet.

Name.....

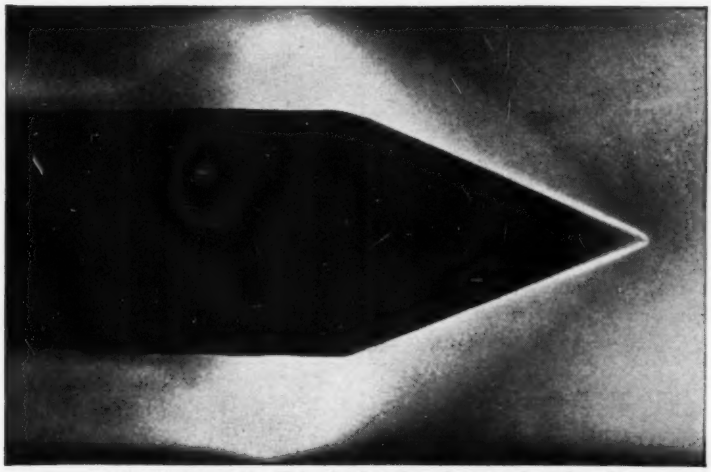
Professional or Design Engineer ☐
Engineering Student ☐ **(Check one)**

Street.....

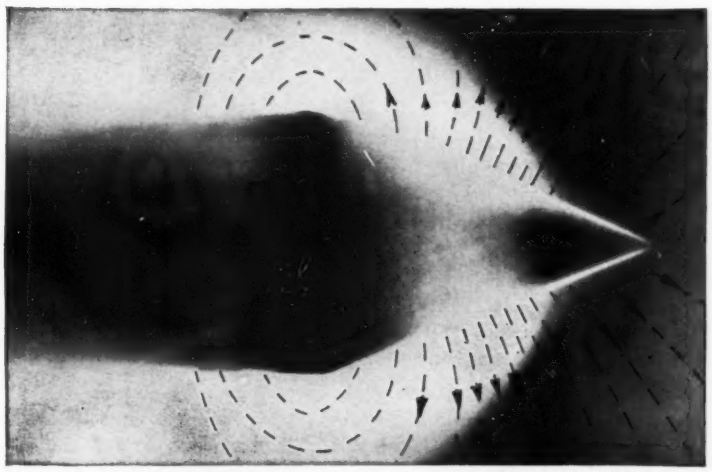
City.....**State**.....

PROGRESS REPORT FROM AVCO RESEARCH LABORATORY

NEW LIGHT ON MHD*



NO MAGNETIC FIELD. This shock tube photograph, taken by emitted light only, shows the typical shock wave configuration formed by high-velocity gas flowing around a pointed cone.



WITH MAGNETIC FIELD. Here is shown the magnetohydrodynamic displacement of the shock wave. The magnetic field is caused by electric current flowing through a coil of wire within the cone. This experiment qualitatively demonstrates the interaction of a high-temperature gas with a magnetic field. This effect would be expected to produce drag and reduce heat transfer to the body.

The Avco Research Laboratory was founded a little more than three years ago for the purpose of examining high-temperature gas problems associated with ICBM re-entry. The success of this research led to the birth of a new corporate enterprise, Avco's Research and Advanced Development Division.

The Research Laboratory, now established as a separate Avco division, has expanded to embrace all aspects of physical gas dynamics. We are currently gravid with several embryonic projects which we anticipate will likewise grow into new corporate enterprises. Our work in the physics, aerodynamics and chemistry of high-temperature gases is growing in the following areas:

Magnetohydrodynamics—
Flight and industrial power-generation applications

Space flight—
Manned satellites
Electromagnetic propulsion

These developments have created a number of openings for physicists, aerodynamicists and physical chemists. If your background qualifies you to work in any of these areas, we would be pleased to hear from you.

Arthur Kantrowitz

Dr. Arthur Kantrowitz, Director
Avco Research Laboratory

P. S. A listing of laboratory research reports indicative of the scope and depth of our activities is available. Address your request: *Attention: Librarian, Avco Research Laboratory, 2385 Revere Beach Parkway, Everett, Massachusetts.*

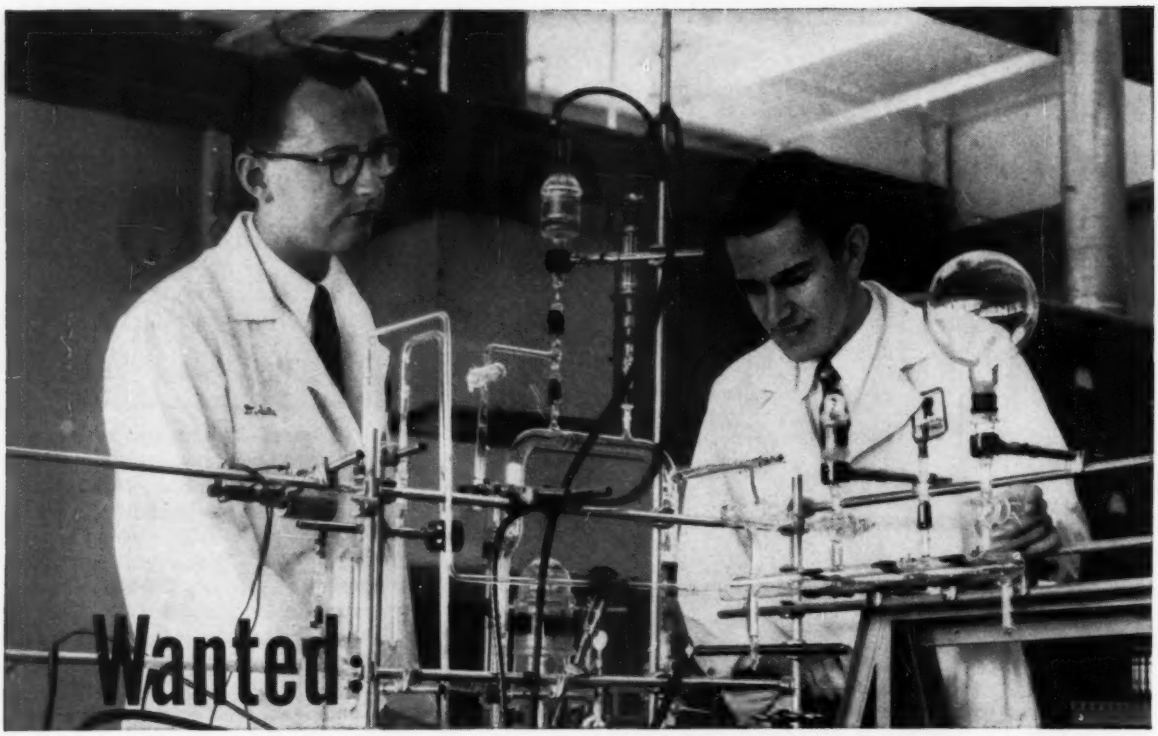
***Magnetohydrodynamics,** the study of the dynamics of electrically conducting fluids interacting with magnetic fields.

Avco RESEARCH LABORATORY

A Division of Avco Manufacturing Corporation/Everett, Mass.

Other divisions and subsidiaries are:

AK Division
Crosley Division
Ezee Flow Division
Lycoming Division
New Idea Division
Moffats Limited
Crosley Broadcasting Corporation
Research and Advanced Development Division



TEAMMATES—Young physicist Donald Swets—MS 1955—teams up with GM Research Laboratories physicist Robert C. Frank (r.) to use mass spectrometer for basic research on gases in metals. Glass tubing apparatus was developed specifically for this GM Research project.

Barrier Breakers

If you're the kind of engineer who wants to do big things in a big way, perhaps General Motors has a place for you.

For at GM, "The Inquiring Mind" is free to roam—free to explore the scientific world in an effort to find new and better roads to progress.

And the men who search for—and find—these new paths, also find opportunity without limit.

For GM is quick to recognize ability—quick to reward it with ever-increasing responsibility—quick to promote talented men to supervisory and executive positions throughout its organization.

Where will you use your abilities and talents? The fields cover the entire spectrum of engineering and science.

Automobiles, trucks, locomotives, aircraft, yes. But power transistors and solar energy, too. Astronautics, astrodynamics and electronics, as well. Rocket propulsion, missile guidance, the entire field of space engineering and science are all concerns of various General Motors Divisions.

And you will not necessarily be confined to just one of these fields. Depending on where your talents lie, you'll find yourself concerned with many fields at various times.

Breaking barriers of technology is a specialty with the engineers and scientists who work at General Motors' 35 Divisions and 126 plants in 71 cities and 19 states—and at our Technical Center near Detroit. If that's the kind of work that fascinates you, let us hear from you.

GENERAL MOTORS

Personnel Staff, Detroit 2, Michigan

GM Positions now available in these fields for men holding Bachelor's, Master's and Doctor's degrees:

Mechanical Engineering • Electrical Engineering • Industrial Engineering
Metallurgical Engineering • Aeronautical Engineering • Ceramic Engineering
Mathematics • Industrial Design • Physics • Chemistry

You're on the right road...

The biggest construction job in history is under way. It's the building of a vast new network of Interstate Highways. Miles and miles of highway. For trucking. For travel. For defense. Some 41,000 miles in all. In addition, many thousands of miles of primary and secondary roads are being built in a greatly expanded "ABC" Highway Program.

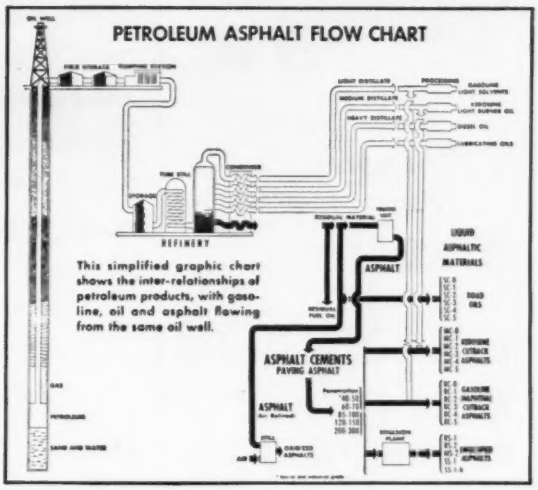
With these new highways will come new industries ... new communities ... a greater share in national life for everyone.

It's a big job ... an important job!

And you're on the right road when you study asphalt technology ... asphalt's characteristics and its applications in pavement construction.

Asphalt pavement is playing a leading role in the construction of the Interstate System.

It now surfaces 81% of State Primary and Municipal Extensions – the nation's most heavily traveled roads—and 85% of all paved roads and streets in the country.



Your contribution – and reward – will depend in part on how much you know about it.

Do you know, for example, how Asphalt fits into the over-all petroleum family? This chart illustrates the inter-relationship of Asphalt with other refined petroleum products.

The semi-solid form – Asphalt cement – is the basic paving material. It is used in hot-mix Asphaltic pavements for roads, airfields, parking lots and thousands of construction and industrial applications.

Liquid Asphalt materials – road oils, emulsions and cutbacks – are used extensively for a variety of construction and specialty applications.

Special Student Kit on Asphalt Technology Free!

Literature included gives you a broad concept of Asphalt products—its sources, production, characteristics and uses. Put yourself on the right road by sending for your kit today. A postcard will do.

THE ASPHALT INSTITUTE
Asphalt Institute Building,
Campus—University of Maryland
College Park, Maryland

Ribbons of velvet smoothness ... **ASPHALT**-paved Interstate Highways

Founded in 1885

THE CORNELL

engineer

OCTOBER 1958 VOLUME 24 NO. 1

Table of Contents

COVER: An alchemist peers through a slit board into an intense, charcoal fire. To find out what was cooking in this furnace, see page 20.

Published monthly—October to May—by the CORNELL ENGINEER, Inc., Carpenter Hall, Ithaca, N. Y. Edited by the undergraduates of the College of Engineering, Cornell University. Second class postage paid at Ithaca, N. Y., under Section 103, Act of October 3, 1917.

Subscription per year: regular $2.00; with membership in the Cornell Society of Engineers, $3.00; student $1.50; single copy $.25.

Vilfredo Pareto...on the lifetime of theories

"The logico-experimental sciences are made up of a sum of theories which, like living creatures, are born, live, and die, the young replacing the old, the group alone enduring. As with living beings, the lifetimes of theories vary in length and it is not always the long-lived ones that contribute most to the advancement of knowledge. Faith and metaphysics aspire to an ultimate, eternal resting-place. Science knows that it can attain only provisional, transitory states. Each theory fulfils its function, and there is nothing more to ask of it."

—Traité de Sociologie Générale, 1919

Under The Hairline

JOIN A WINNER—THE CORNELL ENGINEER

"Join a winning team!" Funny how often we hear this statement but how seldom do we really have a chance to join a winning team. When we think of a winning team, most of us picture a smoothly functioning organization with no room left for any outsider to step in and play a part. When the call does come for new members to join, it is only because the winners have left, and the newcomers find that theirs is no longer a winning team. It's a rare occasion when a person has the opportunity to join a winning team that stays a winner.

And yet when we say, "Join a winning team. Join the ENGINEER," we mean just that. For as far back as any present staff member can recall, the CORNELL ENGINEER has been consistently rated as one of the top three college engineering magazines in the country. So we offer each entering freshman, as well as returning Cornellians, the opportunity to enter the fall competition of the CORNELL ENGINEER, a team which is going to continue to be a winner.

Do you like to write? Then you will enjoy working with the Engineer's editorial staff. It is this group which is responsible for keeping the ENGINEER'S coverage of all scientific news up to date. The editorial staff write copy, edit articles, compose headlines, and organize material for future issues. After a few month's training with the editorial board you may have a by-lined article published which will be read by engineers as far away as Russia.

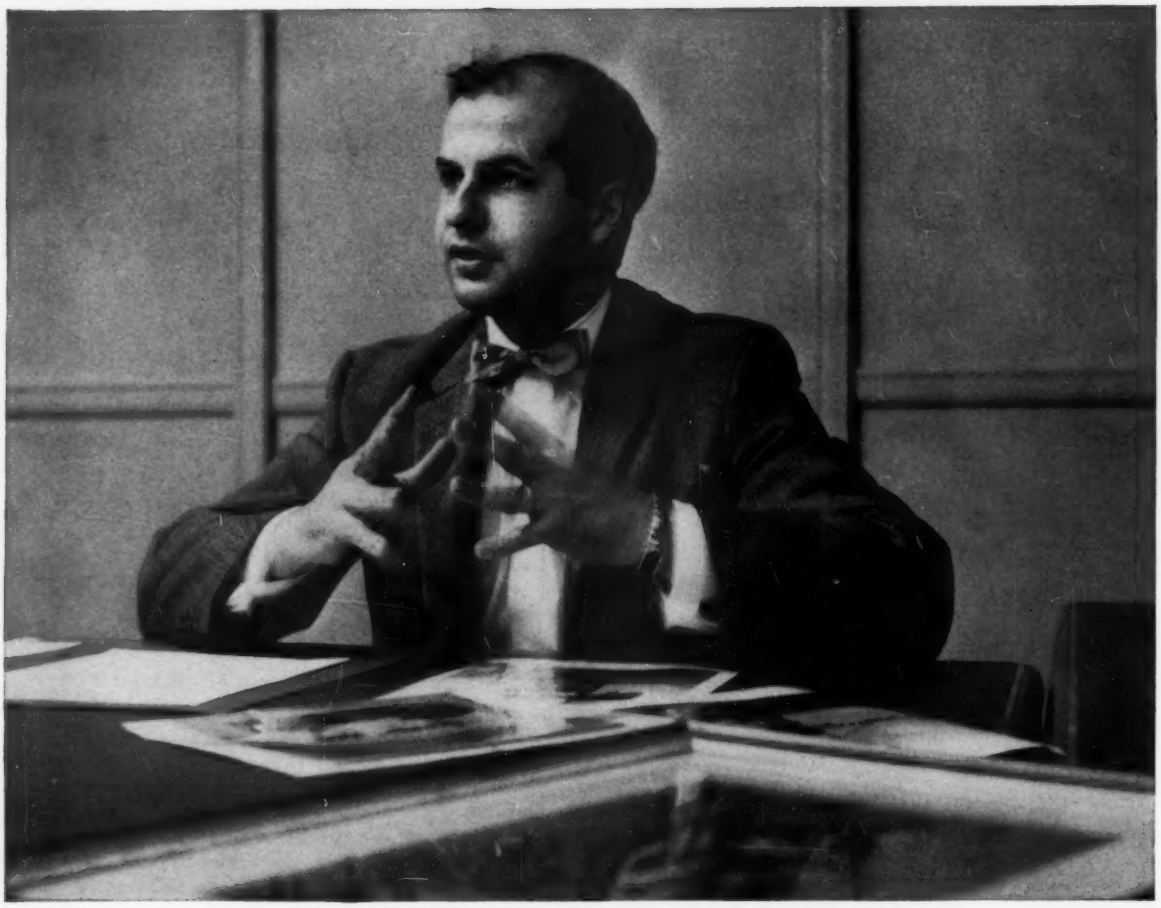
Or perhaps you are interested in financial matters. The financial workings of a complete corporation are the responsibility of the business board of the ENGINEER. Experience and training in advertising, sales, and distribution are all available to the ENGINEER staff member. The business board compet starts out handling subscriptions, mailing, billing, or distribution and gradually works up to the various management positions available to board members. This is a good chance to gain experience in management and finance.

The more artistic competes will be interested in the illustrations board, which does all of the photographic and art work for the magazine. In the past year the ENGINEER published some original illustrations and covers which were very well accepted. Photographs, free-hand drawings, diagrams, and schematic layouts are all used throughout the magazine. We do not hesitate to try new ideas on the ENGINEER. (Last year we became one of the first college magazines to use full color illustrations.) So if you have any original ideas, here is your opportunity.

Perhaps you have had journalistic experience in high school. This will be a help in competing for the ENGINEER. However, lack of experience need not be a drawback to interested competes for we have our own methods of getting out the magazine and everyone will receive ample training during our one term training program.

The ENGINEER staff enjoys publishing an outstanding magazine and we feel you would enjoy working with us. Come to our new office in the basement of Carpenter Hall and become personally acquainted with the staff and organization of the CORNELL ENGINEER.

J.M.W.



Westinghouse is the best place for talented engineers

Howard Zollinger joined Westinghouse in 1951— has since earned MSEE and two U. S. patents

At 28, Howard A. Zollinger, a 1951 BSEE graduate of Michigan College of Mining and Technology is doing " . . . exactly what I always wanted to do." Now a systems design engineer, he specializes in the development of modern materials handling systems to support increasingly automated production techniques. Since completion of the Westinghouse Student Training Course in 1952, he has earned an enviable reputation as an expert in drive systems; and he has submitted fifteen patent disclosures, two of which are about to result in patents in his name.

Most important, *Howard Zollinger is doing exactly what he wants to be doing.* At the completion of his training course, he specifically asked that he be assigned to his present department. And, when he decided that additional graduate study would be helpful, the Westinghouse Graduate Study Program enabled him to combine this study with his regular job. After completing all required course work and his thesis last December, he was awarded his MSEE by the University of Pittsburgh in June.

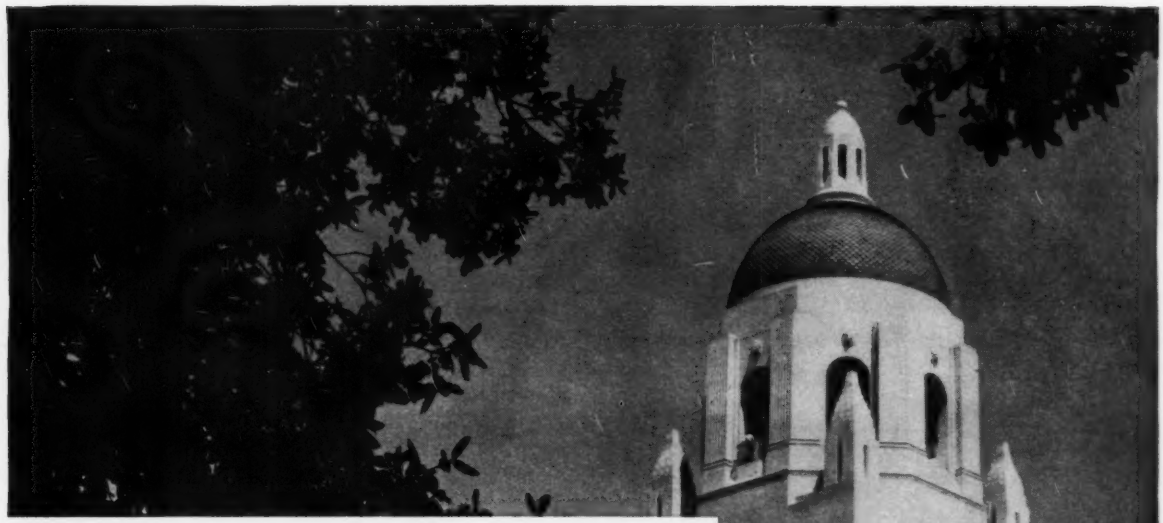
Howard Zollinger is one of many talented young engineers who are finding rewarding careers with Westinghouse. You can, too, if you've got ambition and you're a man of exceptional ability. Our broad product line and decentralized operations provide a diversity of challenging opportunities for talented engineers. Guided missile controls, atomic power, automation, radar, semiconductors, and large power equipment are only a few of the fascinating career fields to be found at Westinghouse.

Why not find out now about the opportunities for *you* at Westinghouse? Write to Mr. L. H. Noggle, Westinghouse Educational Center, Ardmore & Brinton Roads, Pittsburgh 21, Pa.

YOU CAN BE SURE...IF IT'S

Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV MONDAYS



Why Lockheed –

Lockheed's leadership in aircraft is continuing in missiles. The Missile Systems Division is one of the largest in the industry and its reputation is attested by the number of high-priority, long-term projects it holds: the Polaris IRBM, Earth Satellite, Kingfisher (Q-5) and the X-7. To carry out such complex projects, the frontiers of technology in all areas must be expanded. Lockheed's laboratories at Sunnyvale and Palo Alto, California, provide the most advanced equipment for research and development, including complete test facilities and one of the most up-to-date computing centers in the nation. Employee benefits are among the best in the industry.

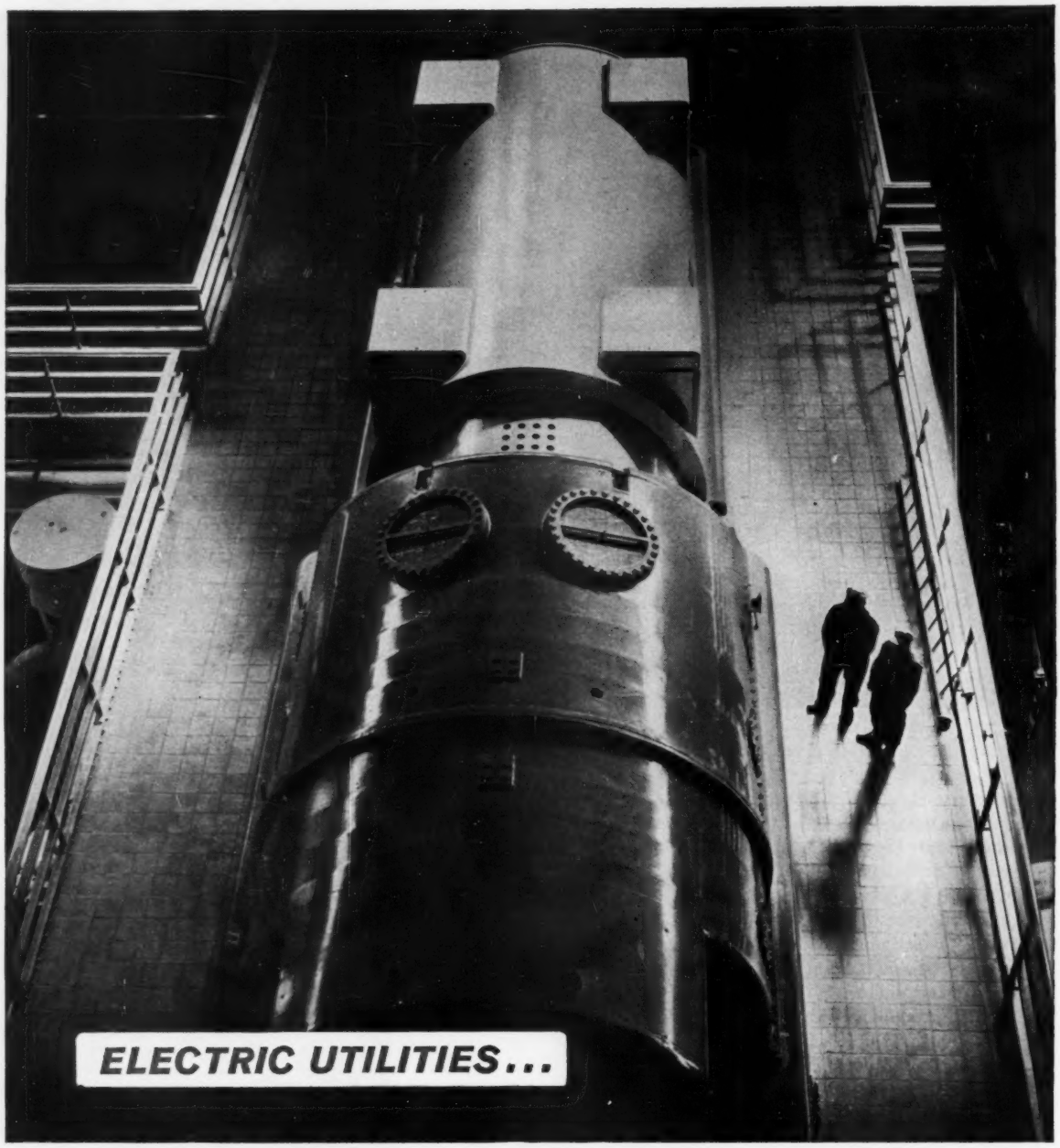
For those who qualify and desire to continue their education, the Graduate Study Program enables them to obtain M.S. or Ph.D degrees at Stanford or the University of California, while employed in their chosen fields at Lockheed.

Lockheed Missile Systems Division was recently honored at the first National Missile Industry Conference as "the organization that contributed most in the past year to the development of the art of missiles and astronautics."

For additional information, write Mr. R. C. Beverstock, College Relations Director, Lockheed Missile Systems Division, Sunnyvale , California.

Lockheed / MISSILE SYSTEMS DIVISION

SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, VANDENBERG AFB, CALIFORNIA
CAPE CANAVERAL, FLORIDA • ALAMOGORDO, NEW MEXICO



Where the Engineer Designs His Own Career

Here's an industry that started big after the war . . . surged ahead in every direction . . . keeps on growing today when others are tapering off . . . and still has its biggest years ahead. The electric utilities business is basically an engineering business. Many of its top executives come from engineering ranks; from systems planning, design, operations, research, or sales; and with backgrounds ranging from electronics and nucleonics to older branches of scientific learning. If you want a career in an *expanding* industry that is based on engineering look to our electric public utilities. We know you'll like working with them. We have been doing it for many years in supplying this great industry with Kerite quality insulated wire and cable. See your placement officer, or write us at 30 Church Street, New York 7, N. Y.

KERITE CABLE

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Talent prospers at Bendix. And proof of this is the vast number of Bendix engineers filling positions of executive responsibility in the world's largest and most diversified creative engineering and manufacturing company. Many are men who only a few years back faced the same problems and decisions now confronting you as a graduate engineer.

Bendix—producer of more than a thousand products for many basic industries—operates twenty-four separate manufacturing divisions; nine of them created or acquired since 1950. All are staffed by key men from within the company.

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Bendix needs young men of talent —graduate engineers wanting to build solid careers with a solidly established, growing organization offering challenging tasks, opportunities for self-advancement, good compensation and a liberal program of personal benefits.

Bendix has special need for graduate engineers in these and related fields: Electronics, Electromechanics, Ultrasonics, Systems Analysis, Computers, Automation and Controls, Nucleonics, Hydraulics, Aerophysics, Instrumentation, Solid State Physics, Combustion, Heat Transfer, Propulsion, Metallurgy, Communications, Carburetion, Ignition, Radar, Sonar, Structures.

See your placement director or write to Dr. Gerald A. Rosselot, Director of University and Scientific Relations, Bendix Aviation Corporation, Fisher Building, Detroit 2, Mich.

A thousand products Bendix AVIATION CORPORATION Fisher Bldg., Detroit 2, Mich. *a million ideas*

HUGHES MASTER FELLOWSHIPS

THE MASTER OF SCIENCE PROGRAM offers direct exposure to a potential professional field combined with academic training leading to a Master of Science degree. One hundred and thirty-five awards are open to applicants receiving their B.S. degree during the coming year in Aeronautical Engineering, Electrical Engineering, Mechanical Engineering or Physics.

You will pursue a two-year schedule of laboratory work and graduate study. During the summer, you will have the opportunity to work under the guidance of experienced scientists and engineers. You may elect assignments based on your interest and technical experience in Radar Systems, Servomechanisms, Computers, Systems Analysis, Information Theory, Automatic Controls, Physical Analysis, Microwave Tubes, Pulse Circuitry, Semiconductor Physics, Photo Devices, Test Equipment Design, Miniaturization, Electromechanical Design, Gyros, Hydraulics, Subminiaturization, Mechanical Design, Instrumentation, Telemetering, Antennas and Wave Guides.

Salary is commensurate with your ability and experience and all company benefits are extended to those participating in the program. Tuition, fees and books are provided and travel expenses outside of the Southern California area are paid.

You may request your graduate school from the following seven institutions: University of Southern California, Stanford University, UCLA, University of Arizona, Purdue University, California Inst. of Technology, and West Virginia University.

Upon attainment of M.S. degree, Fellows may apply for Hughes Staff Doctoral Program.

THE MBA PROGRAM offers fifteen awards to students of Business Administration at UCLA or the University of Southern California. The work program will involve interesting assignments in the administrative areas of the company. Salary and all company benefits are paid in addition to tuition, fees and books.

Consult your College Placement Officer for interview information. Or, write to the Office of Advanced Studies at the address at right.

HOWARD HUGHES DOCTORAL FELLOWSHIPS

If you are interested in studies leading to a Doctor of Philosophy or Doctor of Engineering degree or in post-doctoral research, you are invited to apply for one of the ten awards in the Howard Hughes Fellowship Program.

This unique program offers the doctoral candidate the optimum combination of high-level academic study at California Institute of Technology, and practical industrial experience in Hughes laboratories.

The Howard Hughes Doctoral Fellowship provides an annual award of approximately $7200, of which $1800 is for tuition, books and research expenses. The remainder is the award of a cash stipend and salary earned by the Fellow.

You should plan to pursue research in the fields of Electronics Engineering, Microwave Physics, Mechanical Engineering, Electron Dynamics, Electronic Computing, Physical Electronics, Propulsion Engineering, Solid State Physics, Aerodynamics, Analytical Mechanics or Information Theory.

The Fellowships are open to students qualified for admission to graduate standing. A Master's Degree or equivalent graduate work must have been completed before beginning the Fellowship Program.

Application closing date: January 15, 1959

HOW TO APPLY: *For information concerning either of the Hughes programs described, write, specifying program of your interest, to: Office of Advanced Studies, Hughes Aircraft Company, Culver City, Calif.*

The classified nature of Hughes work makes ability to obtain security clearance a requirement.

the West's leader in advanced electronics

HUGHES

Hughes Aircraft Company, Culver City, California

THE MAN* WITH KOPPERS

"... versatility recognized"

***Arthur Herman** graduated from Johns Hopkins in 1955 and went to work immediately in the Metal Products Division of Koppers as a Design Engineer.

In December of the same year, he was promoted to Supervising Engineer of the Design Section, where he found that Koppers offers truly challenging problems in design engineering.

Then, in September 1957, Art was transferred to the Coupling Sales Department as a Coupling Application Engineer. He is serving in that capacity now.

An employment record alone is seldom descriptive of the opportunities and responsibilities many positions represent. For instance, Art was recently designated as Division Representative to investigate the potentialities of a new product developed by a European manufacturer. This assignment took him abroad.

Art is particularly articulate about his job and the constant challenge it presents for him as an individual.

"When I first started as a design engineer," he said, "I didn't realize the scope of activities in which I'd be called on to participate. Sure, I had good theory and background for design engineering, but I had little concept of the problems of production, and even less familiarity with the techniques of sales or marketing. My work as an application engineer gets me into almost every phase of the business — development, production, marketing, finance, and so forth.

"At Koppers I feel that I receive the necessary guidance to enable me to contribute fully to the Company's activities. I am encouraged to make decisions. If these decisions involve factors with which I am not entirely familiar, I can rely on the judgment and experience of others working with me. At all times, I feel that I have real access to upper levels of management where my ideas have always been received thoughtfully and given full consideration. Now, I feel confident that I am doing a job for Koppers, and, what is equally important, that my associates and supervisors understand and appreciate it, too! I have found that through such methods as the Management Appraisal Program, Koppers makes every effort to recognize and reward good performance."

A lot of things could be said about Art Herman, and the career he found at Koppers. But as the manager to whom Art reports commented recently: "Art's an able man . . . we're glad to have him. He is making a real contribution to the Company. All we in management can do is try our best to develop a man's best qualities and, when he proves to have the versatility that Art has, to see that this versatility is recognized."

If you feel that this is the atmosphere in which you would most like to build your profession and mark your progress, write to the Manager of Manpower Planning, Koppers Company, Inc., Pittsburgh 19, Pennsylvania or contact your College Placement Director.

KOPPERS

KOPPERS

Port of New York Authority

Approximately 147 million dollars (86 per cent of the total project cost) will be spent on the construction of approaches to the bridge. Even the enormous project of drilling through the rock of the Pallisades on the New Jersey side, however, is dwarfed by the complex construction work for the New York approaches. This artist's conception of the completed New York approaches gives some idea of the problem encountered in conducting fourteen lanes of traffic to and from the bridge without disturbing congested city streets and highways.

TRAFFIC RELIEF AT GEORGE WASHINGTON BRIDGE

by

John L. Sarna, B.C.E. '58

It has been common practice in the United States, as well as throughout the world, to establish and build towns and cities on navigable waterways. The combination of commercial and transportation facilities and facilities for water supply, recreation, and the like have been very instrumental in the growth and development of these cities. These advantages, however, do not extend to the field of highway transportation. These waterways, lakes and rivers form natural barriers to surface travel and create a situation of limited access into the cities, necessitating the channelling of all highway traffic into a very limited number of routes.

Most of these routes are not new and were originally designed on the basis of much lower traffic volumes and utilization of local streets which were not designed for heavy traffic volumes in the first place. The tremendous growth of highway traffic since 1946 has swamped most of these routes. One of the best examples of this situation is the George Washington Bridge route in New York City.

The George Washington Bridge spans the Hudson River between the Washington Heights section of Manhattan in New York City and Fort Lee in New Jersey. The river span extends 3500 feet between towers. Since it was first opened in 1931, it has carried about one-third of the traffic crossing the river at New York, and has been one of the major factors in the growth of the northern New Jersey Communities. The bridge was first opened with three lanes of traffic in each direction and room for two additional lanes in the median strip when and if needed.

Structural requirements for a future second deck to be hung under the original traffic deck were included in the design. This second deck could be utilized for either rail or vehicular traffic. The depression years of the 1930's and the second world war prevented any large increase in traffic, and the bridge, in conjunction with the two vehicular tunnels further downtown (the Holland and Lincoln tunnels) was able to handle all the traffic volume without trouble. The New York approaches, which consisted of connections to the local streets and the Henry Hudson Parkway were generally able to carry the traffic with a minimum of delay. In addition, a two lane tunnel was later built under 178th Street to facilitate traffic flow to the East Side of Manhattan.

Postwar Traffic Swamps Bridge

The end of the war brought an almost immediate increase in highway traffic. The annual increase of trans-Hudson traffic jumped from a pre-war average of 1½ million vehicle crossings per year to 5.7 million crossings. This increase was soon very noticeable, especially at rush hours.

The Port of New York Authority, which owns and operates the bridge, immediately set out on a program to improve the bridge facilities. A supplementary tunnel under 179th Street was completed and opened, and the additional two lanes in the median strip of the bridge itself were paved and opened. As these lanes are reversible, depending on the traffic demand, it increased the bridge capacity by about 40%. In 1956 a new bypass eliminated the serpentine downtown connection to the West Side Highway. These undertakings, however, in spite of the high cost involved, were basically stop-gap measures. They were not sufficient to keep pace with the phenomenal postwar growth of traffic. By 1954 the annual traffic using the bridge had reached 33 million vehicles. This was close to the estimated capacity of 36 million vehicles. Delays were becoming increasingly frequent.

This situation had not escaped the planners. Surveys, estimates, and extrapolations were used to predict the future traffic demand, but from planning to practice is often a slow process. Within a few years after the end of the war, the plan of utilizing the proposed lower deck for vehicular traffic began receiving serious consideration. This plan was formally put forth in the ambitious program reported in the Joint Study of 1955[1] put out by the Port of New York and Triborough Bridge and Tunnel Authorities. With a few modifications, this is the plan which was given final approval in the summer of 1957 and is now under way.

The central and controlling factor in the plan of expansion of the George Washington Bridge is the addition of the second deck for vehicular traffic. The addition of this second deck will increase the theoretical annual capacity by 75% to about 63 million vehicles. Since the bridge was originally designed for a second deck, a minimum of structural changes will be required, and only slight modifications will be needed at the anchorages.

The second deck will carry six

[1] Joint Study of Arterial Facilities, New York-New Jersey Metropolitan Area, issued 1955.

lanes of traffic—three in each dition. The area between the roadways will not be paved. This will prevent cars from using it as a passing lane and insure against possible overstressing of some of the supporting members from the extra weight involved. There will, however, be a few turn-out areas for disabled cars in the median strip. One decided advantage of the lower level lanes is that they can be a full twelve feet wide, in accordance with today's design standards. There will be a fifteen-foot headroom clearance for vehicles and a highwater center span clearance of two hundred feet. The combination of the two decks and the reversible center lanes on the top deck will place eight lanes available for the heavier volume direction of traffic at peak hours. This should be sufficient for many years to come.

Approaches Must Be Rebuilt

The job of adding the second deck to the bridge is relatively small, both in cost and in scope, when compared to the tremendous job of rebuilding the approaches to the bridge. It is one thing to add six lanes of traffic to the bridge but quite another to provide sufficient access to these lanes. In many cases the physical capacity of a bridge is controlled more by the physical limitations of the approaches than by the bridge itself. This is the case for the George Washington Bridge.

The New York approaches were designed for pre-war traffic, and the present huge volumes result in frequent tie-ups at peak hours. It was obvious to planners right from the beginning of the project that more than a simple renovation or expansion would have to be done; the entire approach system would have to be rebuilt. This is the largest phase of the entire project.

The George Washington Bridge is primarily a passenger car facility. It is the principal route for heavy traffic between northern New Jersey and the New York counties west of the Hudson and the Bronx, Westchester, New England, Queens, and Long Island east of the Hudson. Trucks that do use the facilities generally are through trucks between New Jersey and points south and New England. Only a small percent have origin or destination in downtown Manhattan.

Under existing conditions connections are provided between the bridge and both the north and southbound roadways of the Henry Hudson Parkway, the 178th and 179th Street Tunnels and the local street system in the Fort Washington Area. The tunnels, each of which has two lanes, connect with the Harlem River Drive and the 181st Street Bridge over the Harlem River. In heavy volume hours traffic demand on the tunnels and parkway connections exceed the capacity of these approaches. As a result, some through bridge traffic must be directed onto the already crowded local streets.

At the time of the Joint Study, certain routes were under construction or planned in New York that would have a major effect on the future distribution of bridge traffic. The Cross Bronx Expressway would link with the Hutchinson River Parkway. The New England Thruway and the Whitestone Bridge would provide a new route serving the Bronx, Westchester and Long Island. The Major Deegan Expressway along the east side of the Harlem River would provide access to Queens and Westchester, while the completion of the Harlem River Drive along the west side of the Harlem River would provide an additional north-south artery serving Manhattan. The future availability of these routes combined with the known origin-destination pattern of the bridge traffic, and the predicted increase in traffic generated by the new construction made obvious the need for additional capacity across Manhattan to supplement the two existing tunnels.

Cross-Town Expressway Planned

It was necessary, therefore, to design an entirely new roadway which took the form of an eight lane depressed highway located between the tunnels. This was quite a radical step for it meant acquiring all the buildings in this strip between Fort Washington and Amsterdam Avenues and relocating over 1800 families—but there was no other solution. The plan of 1954, therefore, called for this eight lane depressed highway to run from the bridge plaza to the Harlem River to connect with the Harlem River Drive in Manhattan, and with a new bridge spanning the River to connect with the Major Deegan Expressway (the New York State Thruway Extension) and the new Cross-Bronx Expressway leading to the Whitestone Bridge and future Throgs Neck Bridge. Combined with the existing tunnels this would be more than sufficient to take the future demand of commercial and automobile traffic.

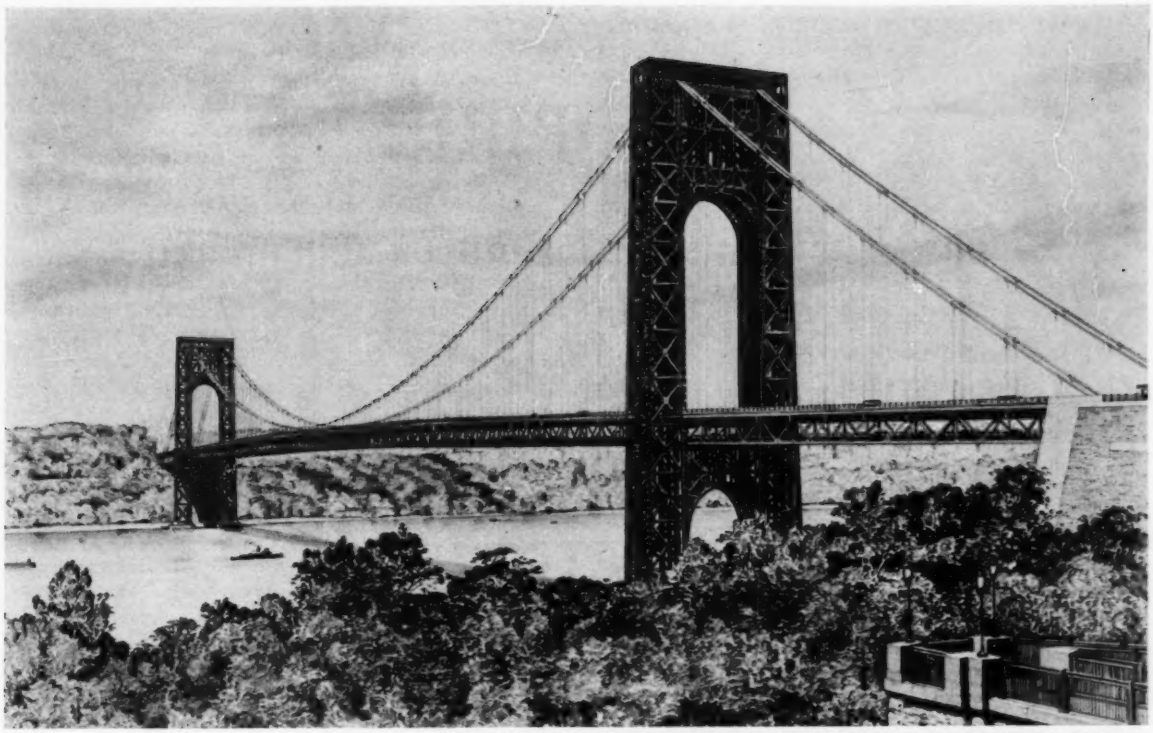
Tunnels to Be Closed

The plan also contemplated the possibility of constructing a bus passenger facility over the expressway. This facility would have a direct subway connection. It would accommodate all uptown bus lines, and thus remove interstate suburban busses from the Washington Heights streets.

One major change has been made in the expressway plan since 1955. The tunnels at present receive their ventilation from seven story ventilation buildings located between 178th and 179th Streets, right in the path of the expressway. The expressway will run below the level of the buildings, but to attempt to support these buildings over the roadway proved to be an extremely difficult and costly job. Economic studies were therefore made comparing the total cost and cost per lane of eight, ten, and twelve lane expressways, with and without utilizing the tunnels.

The plan found to be most advantageous calls for a 12 lane expressway over the same route, and the suspension of operations of the tunnels. The ventilation buildings will then be removed, but the tunnels will be left intact. Should the need ever arise, they can be put back into service using an axial flow ventilation system. This plan also has the advantage of better operating conditions. The additional expressway lanes will have a slightly higher capacity than the narrower tunnel lanes, will be easier to maintain and patrol, and will not cause as much of a tie-up in case of a vehicle failure. The system will, of course, eliminate the expense of operating a ventilation system.

In order to complete the approach requirements for the double deck bridge, the plan also incorporated extensive modifications of the connections between the bridge and the Henry Hudson Parkway.



Port of New York Authority

The new six lane lower deck will only slightly alter the appearance of the George Washington Bridge. Compare the artist's sketch (above) of the completed project with the photograph of the bridge as it stands today (right). The original bridge was designed for a second deck so only a minimum of changes to the structure and the anchorages are required. Extensive construction must be done for the approaches on both ends of the bridge to allow a constant intake and discharge of automobiles.

This includes widening the approach roads and elimination of the sharp right angle turns now present. These improvements also provide for the interchange of traffic between the Parkway and both the proposed new trans-Manhattan Expressway and the local Washington Heights area.

New Jersey Side Also Affected

The New Jersey approaches are also due for some extensive expansion changes. There will not be too many alterations done to the present plaza and approaches to the upper deck, but it will be necessary to add a completely new approach and toll plaza system for the lower deck. The planning and location of these facilities posed the big problem here. The land is highly built up on both sides of the present approaches and anything more than a minimum lateral expansion would result in high costs and extensive local street relocation.

Two possible designs were considered. The six lanes of traffic from the lower level could be brought out to one side of the existing plaza and a new toll plaza constructed along side of, or slightly west of, the existing plaza. The other plan would separate the two lower deck roadways and bring them out along both sides of the existing plaza. Separate twin plazas would then be constructed west of the existing one.

The second plan is the one that was chosen. It requires the taking of the least land, and its connections with the upper deck lanes and the connecting highways beyond are relatively uncomplicated. The lower deck roadways will separate at the Palisades cliffs and run partially in tunnel and partially in open cut along both sides of the upper deck plaza past the toll booths. As the upper deck plaza narrows west of the booths, both lower deck roadways will widen out into the twin plazas. In this way it will not be necessary to

(Continued on Page 34)

Alchemy:

The Forerunner of Modern Chemistry

by

Frank F. Walsh, ChemE '59

Webster's dictionary defines alchemy as "the medieval chemical science, the great objects of which were to transmute base metals into gold and to discover the universal cure for diseases and means of indefinitely prolonging life." This definition is typical of modern ideas of the ancient art, but in reality it includes only a small portion of the areas included in the ancient study of alchemy. Records of the ancient alchemists indicate their studies encompassed philosophy, religion, astrology, occultism, mythology, magic, and other strange fields. It is the purpose here only to consider alchemy as it was related to the eventual development of chemistry.

The records left by the early alchemists are few. When records have been obtained, they have often turned out to be nearly incomprehensible because of the many symbols, formulae, and meaningless allegories used. Thus, much of the early history of alchemy is left to speculation.

Origin of the Art

Early alchemists credit the origin of their art to Hermes Trismegistus —"The Thrice-greatest Hermes"— an Egyptian priest who supposedly lived about 2000 B.C. He was widely revered as the inventor of all useful arts. His followers later elevated him to the rank of the gods. It is from this legend that alchemy became known as the "Hermetic Art."

The true origin of alchemy seems to have been closely connected with the fundamental physical theory of the Four Elements as first laid down by Empedocles, and later expanded by other Greek philosophers to include the concept of the "prima materia" from which all bodies were formed and into which they again might be resolved. This theory and a later development— the concept of a transmuting agent capable of producing the change of one kind of material into another—started the alchemists on their never-ending search for the means of producing the transmutation of base metals into gold, and the Philosopher's Stone which would effect this change.

Another feature which probably added encouragement to the alchemist was the early work done in the field of metal alloys. It is easy to see how the poor analytical methods of the early alchemists and their desire to achieve transmutation of elements would have made it easy for them to convince themselves that they had achieved the goal they were reaching for, when in reality they had only created a new alloy of some of the base metals, or discovered a means of separating gold from its ore.

The similarity of oriental and occidental alchemy suggests a common origin. Its essentials were recognized in both Egypt and India as early as 1500 B.C., and the Chinese system of Five Elements is equally old. The present name for the art, "alchemy," is believed to have originated with Islamic references to Egypt ("al Khem") the country in which the Arabs thought the art had originated.

Idea of Transmutation Lures Many

Whatever its origin, the thought of unlimited riches was too much for many people to pass up, and the art spread rapidly. With it spread many false claims of discovery of the Philosopher's Stone and other means of transmutation; these only served to increase interest in alchemy.

The first testimony of transmutation comes from an unknown writer of the first century by the name of Manilius. He wrote how fire makes possible "the search for hidden metals and buried riches, the calcining of veins of minerals, and the special art of doubling the material in the case of objects made of gold or silver." A later mention of the art of transmutation comes from Pliny the Elder who says the Emperor Caligula, greedy for gold, ordered a large amount of orpiment (arsenic sesquisulfide—a yellow powder) to be calcined; the result was some excellent gold, but the amount was too small to make the process profitable.

In their search for the transmuting element, the alchemists did not fail to investigate any area in

humors of the body. Black was as-

which they thought they might obtain help in their quest. Many felt the Philosopher's Stone could be obtained only with the help of the gods; this led to the addition of altars, on which incense was burned, as standard equipment in many laboratories. Spells and incantations were brought to the aid of technical formulas, since it was believed that supernatural intervention could make possible the evasion of natural order. Indeed, many were staunch followers of the religion Hylozoism which was based on the belief that all matter is endowed with life and feelings.

Nor did the alchemists overlook the possibility that aid in their search might be found in the areas of astrology. Through astrology, the alchemists linked gold and sulfur with the sun, silver and mercury with the moon, and the seven known metals with the seven most prominent heavenly bodies – the sun, the moon, and the five known planets.

Arabs Spread Alchemy into Europe

The spread of the art of alchemy was due in a large part to the Arabian army. In the seventh century A.D., when the Arabs invaded Egypt, they came in contact with the art for the first time, and many of them immediately became interested. As their armies pushed on, the converts took their knowledge of the art through Spain and other countries they conquered, so that by the time of the Crusades the art was well established throughout the European countries. Even today, Islamic alchemy is not dead; there are still individuals in Mecca, Morocco and other areas of the East who cherish old treatises and dream of the day when they will be able to produce the Philosopher's Stone. The effect on science of Arabic interest in alchemy can be seen from the words of Arabic origin which appear in the language of chemistry: alcohol, elixir, aludel, alembic, etc.

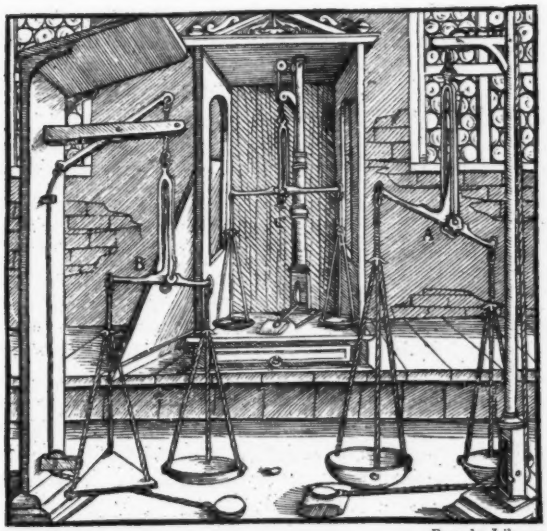
The records of the early Arabic adepts (practicers of alchemy) are well interspersed with fraudulent documents written centuries later and attributed to these early alchemists. However, some authentic early records of this age exist, and from them one can see that the Arabian adepts were mainly interested in the possible applications of alchemy to medicine. They abandoned many of the fantastic features of the art and practiced it mainly as a means of healing. The idea that the Philosopher's Stone might be able to cause healing did not develop until centuries later.

Following its introduction into Europe in the seventh century, the art took on ever-increasing importance until by the fourteenth and fifteenth centuries it had become almost a religion. In fact, many people went so far as to declare that the knowledge of transmutation could be obtained only through the will of God; a number of technical treatises state that no operation should be undertaken without prayers for its success first being made.

Alchemy Claims Discredited

Because the art was based on principles which were untrue and goals which could not be achieved, its growth saw an increasing number of quackeries and absurdities become associated with it. These frauds finally reached such an extent that by the end of the sixteenth century all alchemical claims were discredited.

The extent to which alchemy influenced the lives of the Europeans in the medieval ages is evidenced by the number of prominent people who practiced it. The following is a partial list of the outstanding alchemists of the era. Alchemy seems to have been especially popular among the clergy during the medieval ages. Pope John XXII was an ardent follower of alchemy during the time he was Pope, and Albertus Magnus (a Dominican monk



Burndy Library

Balances used by adepts and early chemists for weighing ores, metals and flukes. The largest, on the right, will support lead weights of eight *unciae* without damage. The one shown on the left is for medium weight, and the one in the rear is for gold and silver, encased in glass to avoid drafts.

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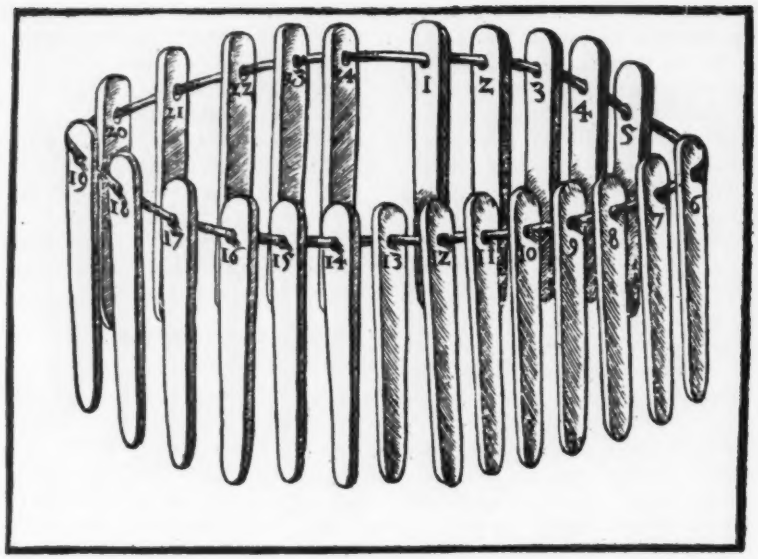
A process for making *nitrum* (soda or potash). The soda is mixed in the circular tub, right, and boiled in the vat (B). It is then condensed in the tub (C) around copper wires and powdered in the mortar (E). Alchemical processes like this one provided a foundation for the development of chemistry.

cused him of quackery. His works

ple and crude pieces of apparatus.

In keeping with the ancient idea



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A set of twenty-four needles for comparing an alloy of gold and silver when rubbed on a touchstone. The first needle is one part gold and twenty-three parts silver and each succeeding needle adds one part gold and loses one part silver up to number twenty-four, which is 100% gold. The system of carats is derived from this method.

who became Bishop of Ratisbon) resigned his see to devote all his time to the art. He later published several books on his findings. One man of the late tenth century, by the name of Gerbert, became so skilled in the art of alchemy that he was reputed by many to be in league with the devil. Despite this fact, he later made his way up through the church hierarchy and finally became Pope Sylvester II.

Roger Bacon, famous for his scientific discoveries in the twelfth century, was an ardent alchemist. His scientific approach to the art resulted in many remarkable discoveries. Aquinas, a renowned scholar, devoted much of his time to study the art, and Raymond Lully, another outstanding alchemist of the period, claimed in his will to have put the grand secret to use to convert 50,000 pounds of base metals into gold.

Numerous Theories Developed

Until the middle of the sixteenth century, the studies of the adepts dealt almost exclusively with the problem of transmuting the base metals into gold, and very little interest was shown toward adapting alchemical theories to the curing of ailments, and similar possibilities. Although many methods were attempted to effect transmutation, several theories emerged that were generally accepted as the most promising possibilities.

One of the most common theories used by the early adepts stated that all metals were derived from the substances sulfur and mercury. Sulfur was chosen because of its combustibility; it was believed to be some form of pure fire (one of the Four Elements) in a material state. Mercury, because of its liquidity, was believed to be closely allied with the element water (fire and water being by far the two most important elements of the four). Mixtures of impure sulfur and mercury, it was believed, could be used to form base metals; ordinary mercury and sulfur, the theories stated, would form gold; and quintessentialized sulfur and mercury, alchemists thought, gave rise to the Philosopher's Stone.

Another theory popular among alchemists was that the important feature in obtaining the Philosopher's Stone was the color changes through which the material progressed in processing. In the operations of the Great Work of preparing the Philosopher's Stone, four principal colors were said to make their successive appearances in the order black, white, citrine, and red. These colors were also associated with the four elements and the four humors of the body. Black was associated with black bile and earth; white with phlegm and water; citrine with yellow bile and air; and red with blood and fire. At a certain stage in the process, the colors of the peacock's tail (or the colors of the rainbow) were supposed to appear. If the colors made their appearance in the wrong order, the operations had to be started over again.

The writings of the Pythagoreans in the fields of harmony, music, and the harmony of the spheres led to the idea of music being an important aspect of alchemical operations. Research along this line reached its apotheosis in 1618 when Count Michael Mayer published a book of fifty musical canons to be used by the alchemists in their work.

At the end of the sixteenth century, the frauds and absurdities associated with the art in increasing numbers finally became its undoing. By this time a period of decadence in the art and ill-feelings toward alchemy and its adepts had started the general decline which would eventually lead to the development of a more scientific approach to the study of the natural sciences.

Alchemy Changes To Chemistry

Indeed, the switch from alchemy to chemistry might have been more rapid if it hadn't been for the change of attention of the alchemists toward the medical, moral, and spiritual values of the Philosopher's Stone. Many alchemists became professed healers of bodily and mental sickness. The active originator of this new development was the man who ancient historians have called "the zenith and the sum of all alchemists"—Paracelsus. The life of Paracelsus is typical of many of the alchemists of the sixteenth century. His father was a physician, and he was trained in the profession, but while still a student, he came under the spell of the Philosopher's Stone and set off in search of the solutions to some of the problems posed by the alchemists.

His fame and fortune were secured when he supposedly cured thirteen princes of "incurable" diseases by the use of metallurgical chemistry, even though many ac-

cused him of quackery. His works are of little value in themselves, and certainly his "discoveries" were worth very little; it was his questioning and criticism of the existing traditions which gained him a lasting reputation as the outstanding alchemist of the period. His vehement attacks on alchemy started the change which finally led to the development of a science from alchemy.

It would be artificial to set a date for the beginning of the period of the transition from alchemy to chemistry. Chemistry received its start in the period of decadence of alchemy and was well on its way by the seventeenth century. The end of alchemy is more definite and can be put at the beginning of the nineteenth century when alchemy was finally discredited and chemistry was put on a firm footing. Few, if any, important discoveries or changes were made in alchemy during the last two centuries, and the records of alchemy during this time show a general downhill trend in interest and research.

The gradual undermining of belief in the principles of alchemy (scientifically speaking) was mainly the result of scientific research and experiment. But it was in no small degree accelerated by the unmasking of fraudulent pretenders. The atmosphere which developed around the art could not help but cause even the most credulous followers to question the power of their art.

Adept's Methods Aid Early Chemists

The relation of alchemy to chemistry is best brought out by a comparison of Paracelsus and Robert Boyle. Paracelsus buried what was good in his reforms under a load of incoherency and charlatanry, while Boyle manifested the cautious, critical temper which gave sustained purpose to his efforts and advanced the cause of scientific research. If it is desired to find one development which marks the end of alchemy, it is the development of the new theory of combustion which brought to an end the art's reign.

The equipment and processes invented or discovered by the early adepts was the part of alchemy which contributed most to the development of chemistry. The alchemists had a wide variety of simple and crude pieces of apparatus. Some of them were the aludels (pear shaped pots, open at both ends, and made to fit into each other), alembics for distilling, retorts and stills for heating and sublimating, flasks for heating in beds of hot sand or cinders, large and small furnaces, athanors (furnaces especially constructed to maintain a certain degree of heat), cucurbits (gourd-like alembics), pelicans (vessels with arms), and so forth. Many of these alchemists' vessels are still in use in our modern laboratories.

Many of the processes used by the alchemists were specific steps to be used in manufacturing the Philosopher's Stone, or were discovered in the search for the correct method of performing the Great Work. Calcination was used for rendering metals more fixed (i.e. robbing them of the qualities which made them unlike gold or silver). Sublimation, the same process that is used today in chemistry, was used as a purifying process to make the material more "spiritual." In keeping with the ancient idea that a thing must decay before it can grow or life can be produced, putrefaction was used as a process for encouraging gold to grow.

The process known as cibation was simply that of feeding the crucible with fresh material. Softening, or dulcifying, was the process of causing a substance to flow or become like wax by the use of special mixtures or infusions and controlled heat. Fermentation was used in much the same way as it is today, and cohobation (repeated distilling) was used to increase the amount of virtues in the final product. The process of liquefaction or melting was called ceration. Solution was used the same way we use it today.

The problem of placing a value on the art of alchemy in the development of science can be approached from many angles. The critic who takes a quick glance at the art may well condemn it for the many charlatans and frauds in its past. The scientist, particularly the

(Continued on page 69)

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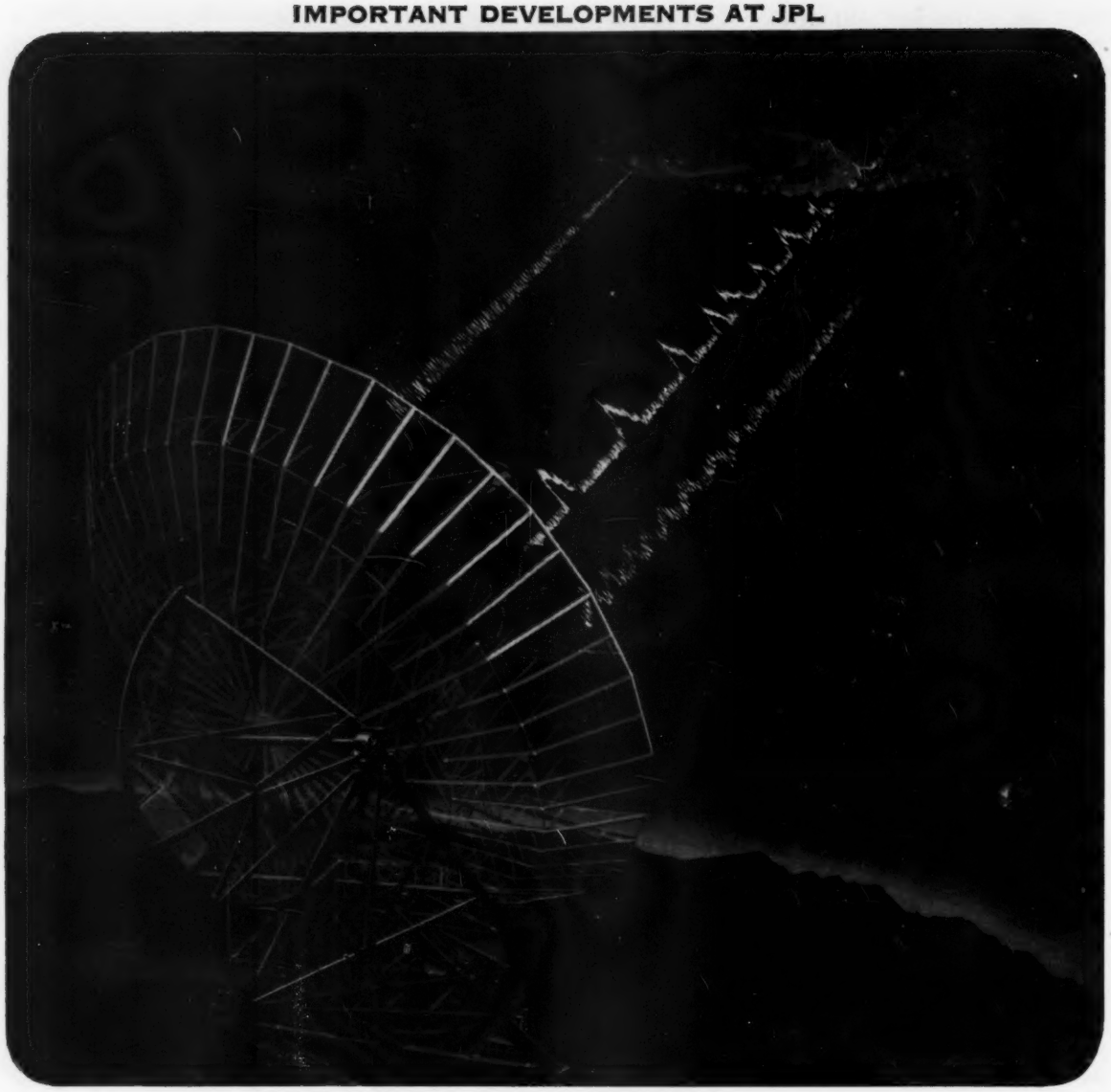
This is a method used by early chemists to extract mercury from its ore. Clay pots (A) holding the ore are placed in the furnace (shown in section, right) and covered with an opercula (B) having two nozzles (C) that lead into collecting vessels (D). The mercury is vaporized by the heat, condenses in the covering opercula and collects in the earthenware vessels. Much of this equipment was developed by alchemists in their search for the Philosopher's Stone.

IMPORTANT DEVELOPMENTS AT JPL



PIONEERS IN EARTH-SPACE COMMUNICATIONS

The exploration of outer space will take a new step forward with the completion of the new giant radio antenna being installed by JPL near Barstow, California. This huge "dish," 85 ft. in diameter, will enable the Laboratory scientists to probe still farther into space problems.

Information thus obtained and combined with lessons still being learned from the successful Army "Explorer" satellites, will provide invaluable basic data for the development of communication systems to serve space exploration programs. Long range communication will begin as a one-way link from space to earth, developing later into tracking and communicating with lunar vehicles at far greater ranges.

This activity will be part of a great research and development program to be operated jointly by JPL and the United States Army Missile Command.

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COLLEGE NEWS

FRESHMAN TUTORING—PARTIAL SUCCESS AFTER FIRST YEAR

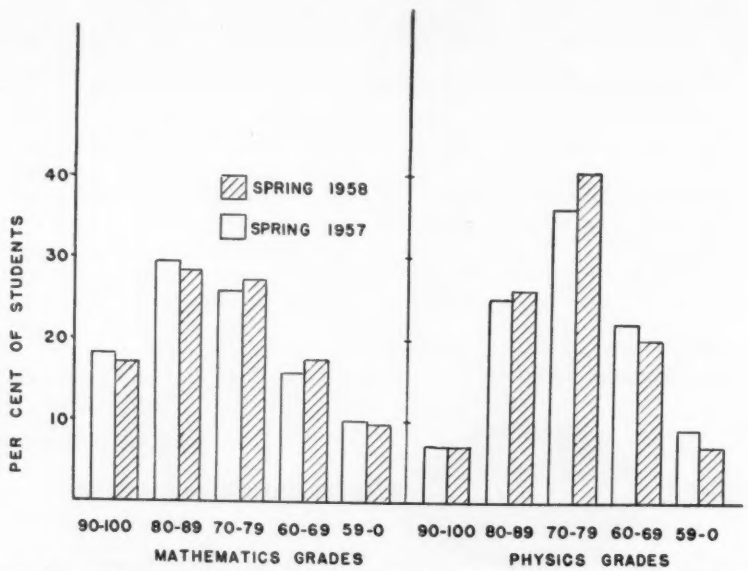
In a determined effort to reduce the number of student failures in the freshman year of engineering, a program of tutoring aid for freshmen was enacted at the beginning of the fall term last year by the College of Engineering. More than sixty upperclassmen engineers were employed by the College to form a corps of tutors placed in private rooms in the freshmen men dorms. They instructed in both mathematics and physics, two of the prime hazards of the freshman engineering student.

After a year of operation, Professor C. L. Cottrell, director of the program, has collected the grades in both courses for evaluation and concluded that the tutoring program was a "partial success." During the fall term, the number of failures in mathematics was reduced to one-third of the number who failed in the preceding year. But in physics there appeared to be no beneficial effect from the tutoring help since the percent number of failures was somewhat higher than it has been on the average for the previous five years. For the spring term, the distribution of student grades (see graph) showed no appreciable change though a greater number of weaker students were carried over from the fall term than in the previous year. In physics, the spring term grades showed some improvement over the 1957 spring term. A larger percentage were in the 80%–89% range and the 70%–79% range and there was a reduction in the percentage below 70% and failing.

Professor Cottrell, a teacher for 35 years and presently freshman advisor in the Electrical Engineering School, is convinced that the students who most needed the help offered by the tutors did not bother to take it. He said, "More than half of the students with failing grades did not visit the tutors more than once or not at all during the term. Only very few students failed who had seen the tutors three times or more." Professor Cottrell is convinced that the blame rests squarely upon the student and the attitudes and ambitions that he brings to college. "Motivation is the key," emphasized the professor, "and unfortunately we have no adequate way of evaluating it. I wish we knew what drives these boys, what makes some students want to learn and causes others to lose interest." When questioned further about the attrition rate, the professor was quick to point out that the student failures constitute a small, though troublesome portion of the student body. They arouse the concern of the faculty, since most of these students are capable of passing their courses. The faculty does not flunk a certain percentage of the class, he noted—the students manage that themselves.

Under the professor's guidance and financed by a fund made available by an unnamed donor, one physics tutor and one mathematics tutor are located in each freshman dormitory. They are available from 7:30 PM to 11:00 PM each night from Sunday through Thursday, the hours of most intensive study in the dorms. The mathematics tutors were supervised by Professor Emeritus Walter B. Carver and the physics tutors by Professor Emeritus Guy E. Grantham during the fall term and by Mr. Stanley Sekula, an experienced instructor in physics during the spring term.

The tutors are selected from applications invited from the fourth and fifth year students whose cumulative averages are 83% or over. The program has proved so popular with the tutors that there is keen competition for the positions. They find that tutoring presents a respectable challenge to their patience, understanding and knowledge; and that tutoring is an ideal time to taste the career of teaching. As tutors, the fourth and fifth year men find that they do more than solve problems for the freshmen. Their prime function is to ease the freshmen into college study habits and mature attitudes towards academics, two big steps towards eliminating the causes of failures. They tell the freshmen how to regulate their time, use study techniques and balance their schedules. Most of the time is spent on math and physics when the tutors help smooth over the rougher theory and problems. Too often the stu-



This bar graph compares the spring term grades for 1958, when the freshman tutoring program was in operation to the spring grades for 1957, when there was no program for Mathematics 162 and Physics 116.

dent can solve individual problems but broader implications and applications escape him. In informal discussions the tutor can tell the student where he has been in the subject and where it will take him. This perspective of the course is often the key to successful exam taking since seldom does the exam duplicate the problems that are assigned for homework.

During the fall term, the tutors were often so busy helping students that the tutors were urged to discourage the better students from asking for help to avoid taking time from those students who were in real difficulty. At the beginning of the spring term all freshmen were told that the tutor's help was for students with grades 75% or less.

Present plans call for the continuation of the program until the end of this year, when final judgment will be made on the effectiveness of the program and whether it will be continued. There are too many variables encountered to permit any sound evaluation after only one year of operation.

SPACE TECHNOLOGY LECTURE TO BE PRESENTED DURING TERM

Space technology, the applied science field that rocketed into national prominence with the launching of the "Sputnik," will be the subject of a filmed lecture series shown this fall at the University. The seventeen lecture programs started on Thursday, Sept. 18 and will continue, one every Thursday, until January. The filmed series is sponsored by the General Electric Advanced Electronics Center in cooperation with the College of Engineering.

Each program consists of two lectures delivered by an expert in the field under discussion. For example, Dr. Wehrner von Braun, Director, Development Operations Divisions, Army Ballistic Missile Agency, will discuss the "Exploration of Mars." Some of the lectures are general in nature. "Why Space Technology?" discusses the motives for a series in space technology, our curiosity about our neighbor planets and the scientific value of knowledge concerning them. In the lecture, "What the Future Holds," a panel of space technology leaders present their own estimates of future problems and future progress.

Most of the filmed lectures are technical in nature. There are lectures on "Flight Dynamics," "Earth Satellites," "Interplanetary Operations," "Power Limited Flight-Optima in Field-Free Space," "Recovery Dynamics," "Rocket Engines," "Structures - Integrated Design," "Space Communications," "Space Medicine" and "Guidance Systems."

The filmed lecture series was produced by the Departments of Engineering and Physical Sciences, University of California, in cooperation with the Ramo-Wooldridge Corporation.

ARCHITECTS PRESENT CAPITAL CITY MODEL TO BRAZILIAN ENVOY

A model of the new capital city of Brazil, as conceived by a class of students at Cornell University, was presented to the Brazilian ambassador in Washington, D.C., Monday evening, May 19.

The model, which would cost more than $10,000 if constructed by a commercial firm, was assembled by 30 students in a city planning class of Associate Professor Frederick W. Edmondson. As a course exercise, the students were told to design the city of Brasilia as they thought it should be. Actually the new capital city was designed by professional architects in Brazil and is now under construction in the interior of that country.

The students were assigned to create a model, showing not only the buildings they would erect on the site, but also the design they would give the city. In their course work they had available the basic information regarding soil, climate, water resources, etc., which had been used by Professor Edmondson and by Professor Thomas W. Mackesey, Dean of the Cornell College of Architecture, when the two were serving as consultants to the Brazilian government in the selection of the site for Brasilia.

Olga Duntuch, daughter of an architect in Sao Paulo, Brazil, and Ralph A. Gakenheimer of Baltimore, members of the class, took part in the presentation ceremonies, which were held in the Pan American Union Building.

A panel discussion of the site-selection techniques employed at Brasilia was held in conjunction with the presentation ceremonies.

(L. to R.) Olga Duntuch from Sao Paulo, Brazil, Michael Rubinstein, Ray Almond, grad student, Kevin Cross, graduate assistant to Professor Edmunson, Stephanie Woods and Clifford Brew are studying the model of Brasilia showing the heart of the city at the left and the Federal capital district jutting into the man-made lake made by the dam at the right.

Participating were Professor Donald J. Belcher of Cornell, who directed the site selection studies; Lucio Costa, Brazilian architect; Dr. Hollister Kent, city planner, of Syracuse; and Dean Mackesey.

PROF. NEWHALL REVISES BASIC PHYSICS COURSES

The first term of a new four term introductory physics sequence is being given to freshmen in the College of Engineering this fall.

This revision in the curriculum is the result of several years' contemplation on the part of the Engineering Physics committee. Professor Herbert F. Newhall, who with Professor Robert M. Cotts will be in charge of the new courses, Physics 121-122, said they would reduce the number of topics covered and devote more time to those dealt with in addition to increasing the volume of contemporary physics formerly covered by Physics 115-116.

Under the new system, mechanics will still be taught in the first term; however, some of the topics normally covered will be omitted and covered later in engineering mechanics. The second term will cover elementary thermodynamics and then begin electricity and magnetism, now covered in the first term of the sophomore year.

The major change will not go into effect until the school year of 1959-60 when six new sophomore physics courses will be added. They will basically cover the same material, but will be tailored for three different levels of academic work. The class will be divided after the first two terms of physics into three sections according to the student's performance in 121-122 and his interest in the fields to be covered. The upper section will advance at a moderately faster pace than the former Physics 117 while the lower section will proceed at a rate slightly less than that of Physics 113.

The curriculum changes stem from a need to have the electrical engineering student introduced to the elementary concepts of electricity before he takes basic electrical engineering in his third term. The new sequence also provides an excellent tie in with mathematics, especially differential and integral calculus as applied to physical motion. In addition, under the 115-116 series, there has been a noticeable degree of nonbeneficial overlapping between chemistry and physics. This is especially evident in the repetition in both courses of thermodynamic properties.

SOLID STATE PHYSICS TO BE STUDIED UNDER NSF GRANT

Cornell University's Department of Physics has been awarded a $45,-100 research grant by the National Science Foundation for a three-year study of physical phenomena of solid materials.

The project, which will be conducted by Assistant Professor Robert M. Cotts and members of his staff, is entitled "A Nuclear Spin Resonance Study of Solids." The research hopes to discover more about the electromagnetic environment of the nucleus in certain materials by studying the "spin resonance," unique behavior of the spinning nucleus in applied magnetic fields.

The goal of solid-state physics is to learn more about the properties of solid materials, says Professor Cotts. Solid-state physics studies the behavior of large numbers of atoms which are in solid form, while nuclear physics considers the detailed structure of the nucleus of the atom itself, he adds.

Professor Cotts became a member of the Cornell University faculty in 1957 after three years on the faculty of Stanford University. He is a member of the American Physical Society.

The grant is part of a program of the National Science Foundation in support of basic research in the sciences, conferences in support of sciences, exchange of scientific information and training of science teachers.

COLLEGE HOLDS E-DAY FOR PROSPECTIVE FROSH

The Cornell Engineering Student Council held the eleventh annual Engineer's Day, May 2, for the benefit of prospective freshmen. Attended by over 2000 students, townspeople, and high school juniors who were brought to Ithaca especially for Cornell Day that weekend, the affair featured exhibits by all the engineering schools and the College of Architecture.

Each school organized exhibits in their own buildings depicting the various phases of that particular field of engineering. To add to the interest of the participants, the annual competition for the best exhibit was held. They were judged on the basis of organization and interest. Breaking a string of several successive wins by the School of Electrical Engineering, the Chemical Engineering School received the first prize cup and $35. Electrical Engineering was second and Civil Engineering, third.

Two students are dumping rough castings into the sand box in the foundry as a demonstration on E-Day. The castings have just solidified and are too hot to be touched by hand so long handled tongs must be used.

HEAVIER PROTON DISCOVERED BY NUCLEAR STUDIES LAB

Cornell University physicists have taken another step in science's age-old search for the ultimate building block of nature.

Professor Robert R. Wilson, director of Cornell University's Laboratory of Nuclear Studies, disclosed that the laboratory may have discovered a new form of the proton, one of the fundamental components of the nucleus of the atom. This new form is two-thirds heavier than the normal proton.

The findings are the result of experiments by nuclear physicists at Cornell University. The experiment used the new one-billion volt synchrotron, a highly developed and more powerful form of the cyclotron, or "atom smasher."

The powerful synchrotron at Cornell University is like a microscope, states Professor Wilson, its designer. It enables physicists to "see" inside the proton, a particle so small that 10^{24} of them would weigh only one ounce.

At first the experiments were performed using x-rays produced by a 300-million volt synchrotron. Scientists were able to produce a form of the proton weighing one-third more than the normal form by bombarding it with the x-rays. With the higher energy of the billion-volt synchrotron, the new form of the proton was produced. This process corresponds to being able to see deeper into the proton.

The new form of the proton is temporary, for it soon reverts to its normal form by emitting tiny particles called mesons. The meson is one-sixth as heavy as the proton and hundredths of times as heavy as the electron. Physicists believe that the surface of the proton consists of a fuzzy cloud of these mesons and that the different forms of the proton may correspond to different motions of this cloud.

At the higher energy level of the new Cornell University synchrotron, the k-meson, a new and heavier meson, is emitted. Perhaps, Professor Wilson states, these mesons exist deep within the proton too, or they may just be produced by the x-ray bombardment. As the energy of the x-rays is raised, deeper regions of the proton will be probed and its core, if one truly exists, may be seen.

SPRING TERM ENGINEERING HONORARY ELECTIONS

Tau Beta Pi

Maxwell W. Davis, ME '08; Prof. Gordon P. Fischer, CE; Salah Elmahgraby, ME Grad.

'58

William D. Forgeng, MetE; Charles A. Haynie, EP; Duane T. Heineman, CE; George S. Hoover, Arch; Henry G. Kammerer, MetE; Larry M. Lidsky, EP; John C. Maclay, ME; Jay L. Markley, Che; Lewis W. Miller, ME; James P. Naismith, CE; Theodore F. Olt, Jr., MetE; Martin H. Sahn, CE; Raymond W. Sears, Jr., EE; James F. Scudder, ME; Paul P. Tregurtha, ME; Theodore A. Wilson, EP; John R. Wolberg, ME.

'59

Donald G. Armstrong, CE; Lewis L. Bucciarelli, ME; Lee T. Corbett, Arch; John W. Dougherty, CE; James M. Edgar, ChE; Harvey L. Fein, ChE; David M. Koppes, CE; Arther R. Kraemer, EE; Cartan B. Kraft, ME; Linn F. Mollenauer, EP; Peter S. Palmer, EE; Russell C. Palmiter, Arch; Enn Tammaru, EE; Howard M. Taylor, ME.

Pi Tau Sigma

Mechanical Engineering Honorary '59

Harry A. Fertik, Gerald S. Freedman, Meyer A. Gross, Gilbert D. Herr, Malcolm W. Johnston, Bruce D. Marcus, Pierce W O'Hearn, Alan J. Seelenfraund.

'60

Peter Arden, Charles M. Beck, Donald R. Brewer, Jeremiah D. Buckley, John P. Evans, Marc Fishzohn, Arthur Geoffrion, Edward J. Ignall, Thomas B. Kempster, Robert C. Metzger, Joseph H. Penrose, Roger W. Robinson, Robert Shaw Jr, James G. Wray.

Eta Kappa Nu

Electrical Engineering Honorary

'58

Edward J. McKinney, Francis F. Mausolff.

'59

Eugene R. Avery, Noel M. Herbst.

'60

Richard P. Fellows, Jeffrey I. Frey, William L. Quackenbush.

Pros-ops

Chemical Engineering Honorary

'58

Richard D. Dent, Theodore F. Olt, William L. Walker.

'59

Barry F. Croasdale, John W. Nestor, Jr., John M. Walsh III, Bruce A. Whilton, Edward M. Yates.

'60

Nelson T. Joyner, Jr., Robert P. Merrill, John Q. Teare.

$27 MILLION SPENT AT CORNELL DURING YEAR FOR RESEARCH

Cornell University spent three times as much money in research during the academic year just ended as it did ten years ago, according to T. P. Wright, vice president for research, who warns that even greater emphasis and support must be given research and education in this country if it is to achieve "intellectual supremacy, once possessed but more recently lost or at least seriously challenged."

Dr. Wright saw the need to "realize that a third component of national power has been added, of equal or greater potential compared to the strength of armed forces and national economy. This is 'intellectual pre-eminence.' This is the real significance of the Russian satellites, and of our own.

Total dollar volume for sponsored research projects at Cornell reached $27,274,000 last year, as compared with $9,200,000 in 1949, said Dr. Wright. Cornell's Aeronautical Laboratory at Buffalo, N.Y., a self-supporting unit of the University, spent nearly half the total amount—$13,151,000.

The field of aeronautics leads in research activity. Next in importance from the dollar standpoint is agriculture, then medicine and nutrition, then physical and biological sciences, the social sciences, engineering, veterinary medicine and the humanities.

BRANDENBURG RECIPIENT OF THE HAMILTON AWARD

Richard G. Brandenburg, past editor-in-chief of the CORNELL ENGINEER, is the recipient of the Hamilton Award for 1958.

The award, a Hamilton watch, was presented to Dick at the annual banquet of Tau Beta Pi, engineering honorary society, on Sunday, May 11, by Assistant Dean of Engineering John McManus.

The award was established by the Hamilton Watch Company to encourage the development of a broader background and perspective among technically trained students. Brandenburg received the award for his achievements in academic and extracurricular activities. He ranked fifth in a class of 108 mechanical engineering students.

(Continued on Page 60)

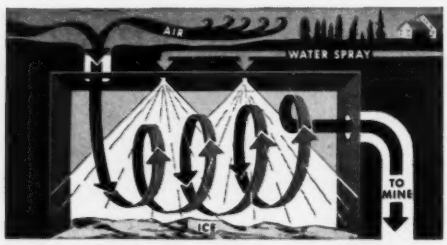
John F. McManus, Assistant Dean of the College of Engineering, presents the Hamilton Award to Richard G. Brandenburg. Looking on is Scott Lewis, president of Tau Beta Pi.

Freezing water to warm a mine

Inco shows a king-size operation that helps mine more Nickel

The bigger the mine, the more men at work, the more *air* they need. Gales of air. Warmed in winter. Cooled in summer. That's the reason for this mammoth "air conditioner" in an Inco-Canada mine.

In winter it raises the temperature of cold air from outside *by making ice.* In summer it uses the ice to cool air that's too hot! (See diagram below)



In winter, cold air is blown through sprays of warmer water. The water loses its heat, freezes into mountains of solid ice. In the process, the latent heat of freezing is transferred to the air, warms it up for use inside the mine.

At full capacity in a winter season, this system alone can generate as much heat as 350,000 gallons of fuel oil. During this period, 150,000 tons of ice may form. (See photo at left)

Installations like this are expensive in time and money. Such outlays are typical of many made by Inco-Canada. Their cost adds up to millions. Results are—to continue the increased production of Nickel.

Mining for Nickel is a 45-minute color film loaned to high school science groups, college engineering classes and technical societies. Write to Educational Service, Development and Research Division,

The International Nickel Company, Inc.
New York 5, N. Y.

INCO

International Nickel

The International Nickel Company, Inc., is the U. S. affiliate of The International Nickel Company of Canada, Limited (Inco-Canada) — producer of Inco Nickel, Copper, Cobalt, Iron Ore, Tellurium, Selenium and Platinum, Palladium and Other Precious Metals.

A mountain of ice, built up in this inside-a-mine "air conditioner." The rock chambers, or "stopes," where the ice forms, are high as a 23-story apartment, big enough to house 300 families. Things have to be done in a big way to get Nickel in the tremendous amounts used by industry to make metals that perform better, longer.

WE WANT MEN TO CREATE TOMORROW'S HEADLINES!

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...NEWS IS HAPPENING AT NORTHROP

NORTHROP AIRCRAFT, INC., Beverly Hills, California

Sperry Gyroscope Co.

TAKING THE ROCK 'N ROLL OUT OF SHIPS

by

William Krossner, ChemE '61

Being aboard a rolling, unstable ship on the high seas is one of the most unpleasant experiences encountered in ocean travel. The instability of such a ship results from its susceptibility to wave disturbances. Not only passenger liners, but cargo transports and ocean going missile carriers are subject to such influence by the sea.

Many devices have been proposed in the years since 1850 to combat rolling, but recently interest has been turned in the direction of controlled fins, or hydrofoils, projecting from the hull of a ship.

Strangely enough, in the age of sails, rolling was not a severe problem because the typical ship hulls of the day, in addition to the sails themselves, tended to eliminate rolling. But with the advent of steam and streamlined hulls, shipbuilders realized that for passenger comfort, fuel economy and sailing efficiency rolling had to be controlled.

The Ship As a Complex Mover

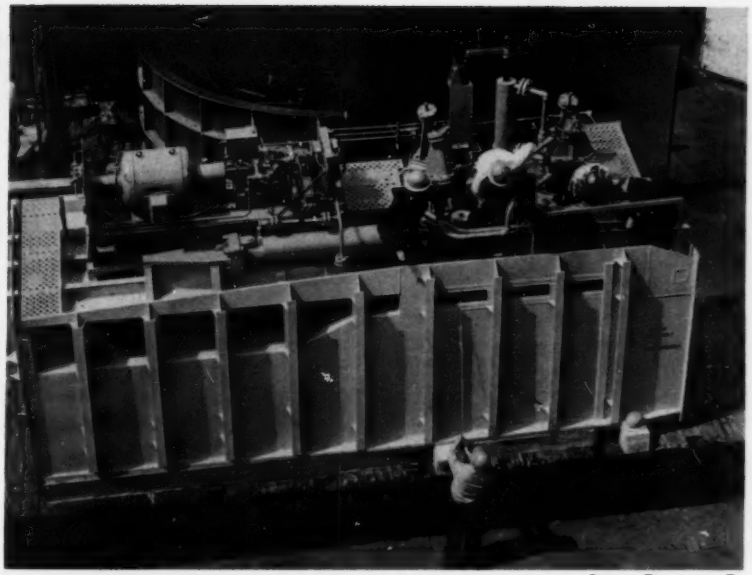
The first phase in meeting any problem is analysis; and in a physical problem, the analysis takes the form of a mathematical model coupled with physical experiments.

A ship is subject to six types of motion. Each type of motion, besides being dependent on the sea in which the ship moves, may be aggravated by the ship's own moving parts—the propellers, the rudders, and the stabilizing system, if

any. Each motion is not independent but is, to a degree, related to one or more other kinds of motions.

Turning from motions of the ship to the primary producer of the motions—the wave—one finds that the wave imparts two distinct disturbances to the ship: first, the turning effect on the ship (the effect seen when the deck tilts); second, the drift motion of the ship (the horizontal displacement from the path).

From considerations such as the above it is possible to write relevant differential equations and to solve them. With these equations in hand it is a question of developing physical devices which can be used to reduce roll effectively and yet economically. As mentioned before, many devices have been considered — gyroscopes, moving weights, propellers, "U" and seaducted tanks and fins. Recently two American ships, the S.S. Mariposa and the S.S. Monterey were installed with identical activated-fin stabilizers.



Sperry Gyroscope Co.

A complete fin stabilization unit is checked before installation into the hull of a ship. The ideal location for this unit is the point of maximum beam and as close as possible to the ship's pitching center.

The Fins Must Be Active

The overall objective of any stabilization system must be to keep the wave force opposed by another force of equal magnitude. Since the waves vary in magnitude, it is necessary to have varying opposing forces. Therefore, the fins must be movable to produce different forces.

The fins, as can be seen from the illustrations, are pocketed in the side, or hull, of the ship. The ideal location is as deep as possible, at a point near the pitching center of the ship. In addition the fin location should be at the point of maximum beam. If these factors are realized, the efficiency of the fins' operations will be maximized.

The fin, fourteen feet long and seven feet wide, is streamlined. The flap, or trailing edge, links to the fin by synthetic materials, for the flap must move up or down at varying angles. The total fin also moves up or down. Seawater is very corrosive; consequently special metals must be used for all surfaces.

The fin is designed for a lift capacity of 204,000 pounds—over 70 tons. The maximum tilting torque is 57,000 pound feet, and the maximum fin drag 75,000 pounds. The maximum fin tilt angle is 25 degrees; the maximum flap angle with respect to the fin is 37½ degrees. The rapid tilt rate is unusual—close to 30 degrees per second.

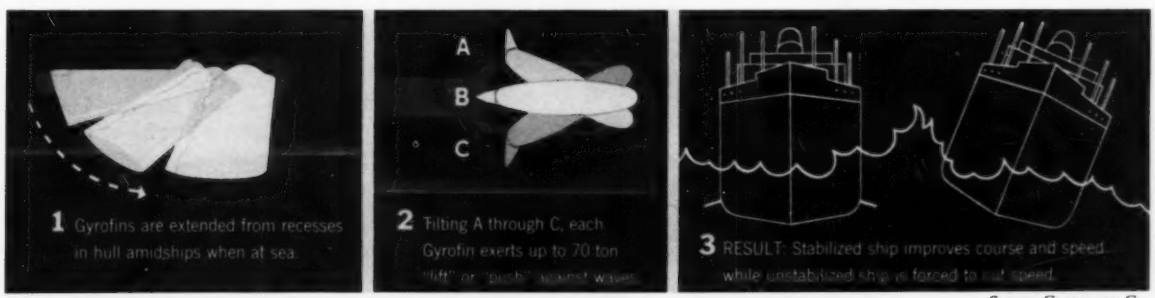
The Fins Must Be Controlled

It is all very well to say that the wave force, actually a wave moment, must be opposed by a moment of equal magnitude, but how do the ship operators know what moment a particular wave produces? Even if they could stand by with measuring instruments under most conditions, the measurements would be difficult, and in severe conditions such as hurricanes, impossible. Servomechanisms provide the answer.

The simplest common servomechanism is the thermostat. Here heat registers on a bimetal strip. If the room is too warm, the bimetal strip bending away from the contact switch, shuts off the furnace. When the room gets too cold, the bending strip, now moving the other way, moves into contact with the switch and turns on the furnace.

This simple servomechanism uses feedback. Signals from the actual situation in the room, control the future situation in the room.

There are three sensing elements for the fins: a linear accelerometer measures the roll angle, a gyroscope measures roll velocity and an angular accelerometer measures the small roll acceleration. These sensing devices deduce the measurements from the ship's motions. A computer then combines the three



Sperry Gyroscope Co.

sources of information and sends appropriate commands to the stabilizing fin machinery to produce a stabilizing moment. Each fin receives identical orders from the computer; thus, the stabilizing moment is applied in the form of a couple. If the ship still exhibits a tendency to roll—that is, if differing wave forces now exert a different moment on the ship—the sensing elements detect the new moment, and new orders are sent to the fin machinery by the computer.

The three sensing elements, as well as the computer, are located in a bridge control station.

A Synopsis of Operation

To summarize, the action of the stabilized fins and servocontrol system may be broken down into five steps.

1. The ship is struck by a wave which produces a turning effect on the entire ship, tending to change the deck level from horizontal.

2. The roll accelerometer detects the roll acceleration, and transmits a signal to tilt the fin.

3. The velocity-measuring gyroscope sends a supplementary signal in case the previous signal was insufficient.

4. If the roll persists the roll-angle sensor sends a further signal to adjust the fins.

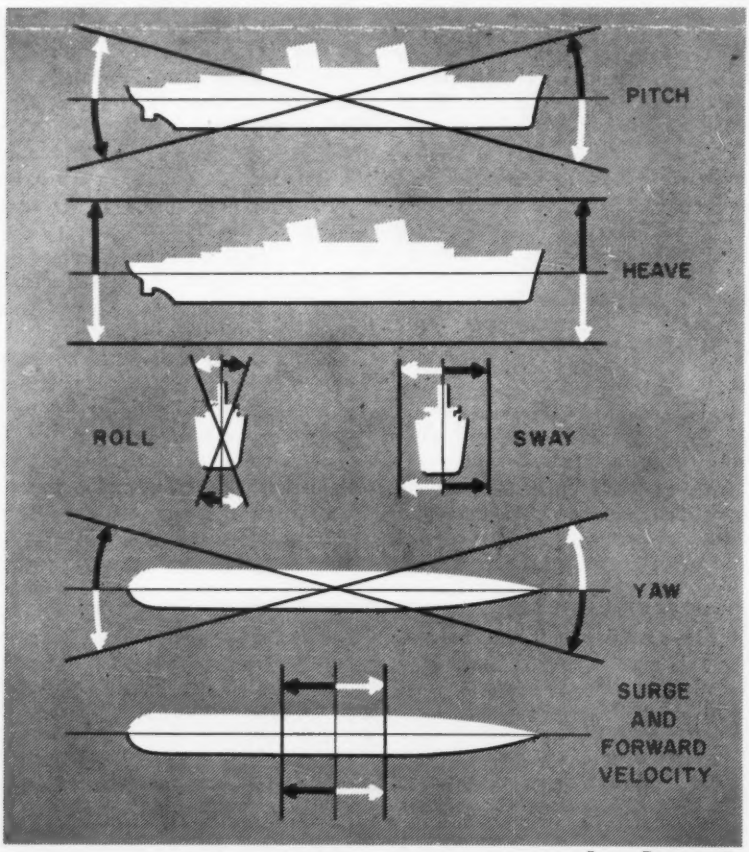
5. As the fins move a lift moment counteracts the roll moment, and the ship is stabilized.

The benefits of roll stabilization divide themselves into three areas.

In the area of passenger service, passenger comfort is increased. Finicky land-dwellers may no longer get seasick on extended voyages, and may thus be induced to travel more by sea.

In the area of naval warfare, stabilization enables guns to be fired more accurately, and, in this day of missiles, permit missiles to be fired from the stable platforms they demand.

In the area of commercial cargo-carriers, stabilization permits greater fuel economy, because ships can go farther in heavy seas. Cargo damage is lessened, and more fragile cargo can be transported.



Sperry Gyroscope Co.

The ship to be stabilized is treated as a dynamic system having six degrees of freedom.

TRAFFIC RELIEF

(Continued from Page 19)

widen the net approach width and as a result, little land need be taken.

Beyond the twin plazas and their toll booths, the roadways from the two decks will connect with U.S. Routes 1 and 46, New Jersey 4, and the future Bergen County Expressway. The Palisades Parkway will keep its separate toll plazas from the upper deck. In accordance with the policy of the Port of New York Authority, access will be provided equally to and from both decks.

The original design of the George Washington Bridge contemplated the possibility of a second deck for either vehicular or rail use. While the prospect of rail rapid transit across the Hudson at this location does not appear to be an immediate consideration, nevertheless, in the public interest, the planned development of the lower level would permit rail rapid transit to be accommodated at any future time. This would be done by converting the two center lanes of the lower level to a double-track rapid transit line, leaving the four outside lanes for vehicular traffic. The expanded Bridge approaches would be compatible with such usage of the lower level. Extensive connections, however, will be required at both ends of the bridge, and no attempt has been made to determine the economic feasibility of such a transit line.

Completion Date Is 1962

The latest estimate of the total cost of the entire project is 182 million dollars. Of this figure, only about 25 million will be applied to the construction of the lower deck itself. The rest of the amount will be used for the approach systems. The trans-Manhattan Expressway alone will cost about 90 million dollars, including the cost of real estate.

The second deck and approaches will be completed in 1962. It will be quite a job to keep the bridge operating during construction, and it will be interesting to see just how it is accomplished. A certain amount of delays and detours will be unavoidable, but they will be kept to a minimum, and the completed project will certainly justify any inconveniences involved.

DU PONT PLANTS AND LABORATORIES IN 26 STATES OFFER VARIED JOB LOCATIONS TO TECHNICAL STUDENTS

BENEFIT PROGRAM MEANS ADDED INCOME

by R. G. Alleman
Du Pont personnel representative

Don't forget the "extras" of an employee benefit program when you compare the job offers and salaries of different companies. At Du Pont, these extras mean added income that doesn't always meet the eye. They include life insurance, group hospitalization and surgical coverage, accident and health insurance, pension plan and paid vacation.

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Today there are men and women carving out careers with Du Pont at more than 75 plants and nearly 100 laboratories spread throughout 26 states. Last year the Company spent $220 million for new plants and for increased capacities at existing installations. This year new plants have already been put into operation in Virginia and Michigan. Six more are under construction. Others are planned for the near future.

Most Du Pont units, it is true, are located east of the Mississippi. Company headquarters, for example, along with many labs and plants, are located in and around Wilmington, Delaware, which is a pleasant residential area within easy reach of Washington, Philadelphia and New York. But there are also plants and laboratories in California, Iowa, Kansas and Texas, and plants in Colorado, Missouri and Washington.

Wherever you're assigned, you'll be proud of the Du Pont Company both on and off the job. You'll find the people you work with friendly, stimulating, and active in the life of the community.

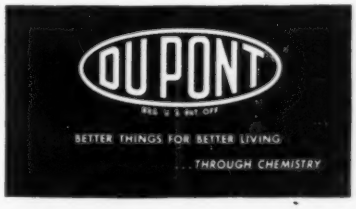
MECHANICAL ENGINEERING MOVIE AVAILABLE FOR A.S.M.E. MEETINGS

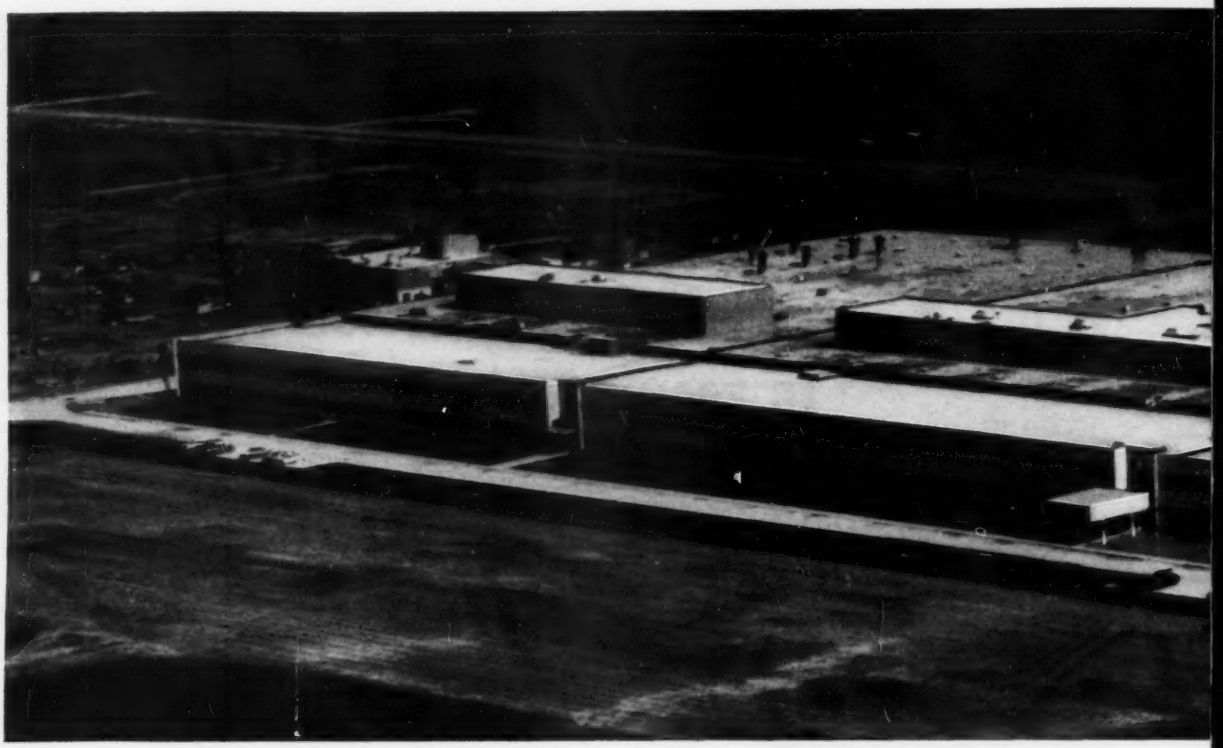
There's a great demand for mechanical engineers at Du Pont. In fact, the ratio of mechanical to chemical engineers is just under 1:2. Whether your chosen field is research, development, plant engineering, production supervision or sales engineering, you'll find a good future at Du Pont.

If you would like to learn in detail what mechanical engineers do in the chemical industry, arrange to see the Du Pont film, *Mechanical Engineering at Du Pont*. It is available at no cost for A.S.M.E. chapter meetings, fraternity house and dormitory showings. Write to Room 12421 Nemours Building, E. I. du Pont de Nemours & Co. (Inc.), Wilmington 98, Delaware.

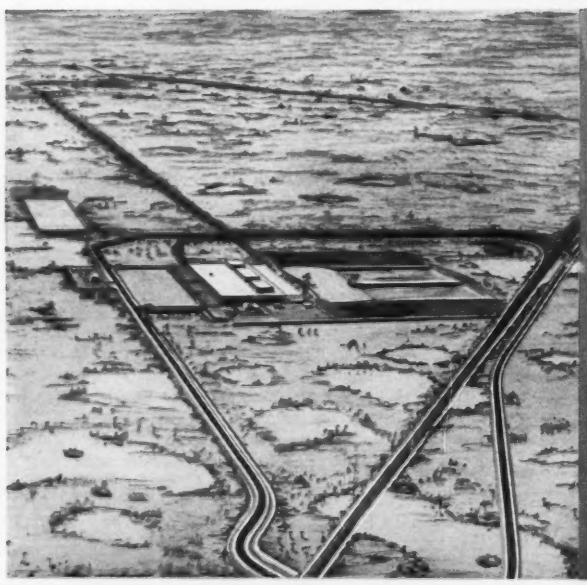
SEND FOR INFORMATION BOOKLET

Informational booklets about Du Pont are yours for the asking. Subjects include: mechanical, civil, metallurgical, chemical, electrical and industrial engineers at Du Pont; technical sales, research and development. Just name the subject that interests you and send your name and school address to E. I. du Pont de Nemours & Co. (Inc.), Room 12421 Nemours Building, Wilmington 98, Delaware.

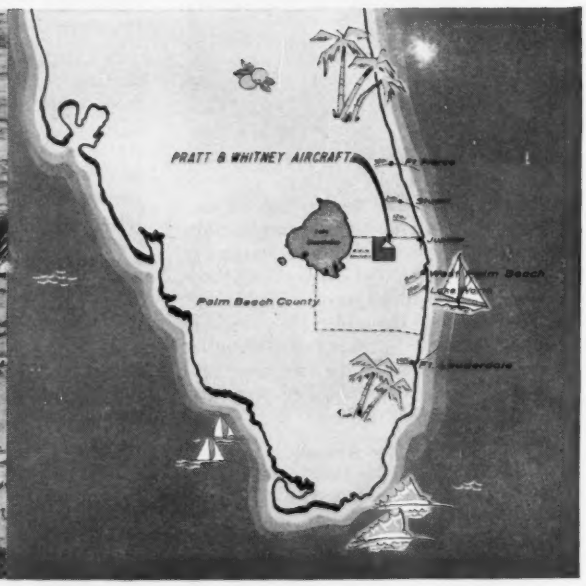




FLORIDA RESEARCH AND



ISOLATION—Ten square miles comprise the site of Pratt & Whitney Aircraft's new Florida Research and Development Center. Experimental shops and offices covering some 17 acres are in the foreground, while the tests areas, barely visible in upper left, lie four miles in the background.



LOCATION—The new Center is located at United, Florida, midway between West Palm Beach and Lake Okeechobee, in the upper Everglades area. It is almost surrounded by a wildlife sanctuary. Most employees live in the cities and towns along the east coast of Florida, driving to the Center on excellent new highways.

DEVELOPMENT CENTER...

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STRAIGHT TALK TO ENGINEERS

from Donald W. Douglas, Jr.

President, Douglas Aircraft Company

I'm sure you've heard about Douglas projects like Thor, Nike-Ajax, Nike-Hercules, Nike-Zeus, Honest John, Genie and Sparrow. While these are among the most important defense programs in our nation today, future planning is moving into even more stimulating areas.

Working as we are on the problems of space flight and at the very borderline of the unknown, engineering excellence in all fields is essential. For you engineers who can help us move forward, opportunities are almost as limitless as space itself.

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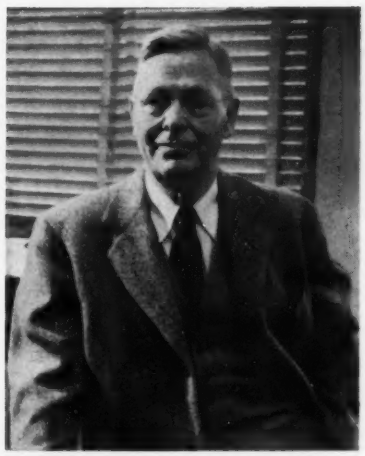

CORNELL ENGINEERING— A FIVE YEAR INVESTMENT

Dean Hollister came to Cornell in 1934 as director of the School of Civil Engineering. In 1937, he was elected Dean of the College of Engineering. He was responsible for the establishment of the five year curriculum in engineering at Cornell, one of the first such programs in the country. Dean Hollister has served as president of the American Society for Engineering Education, and as a member of the second Hoover Commission. He is presently chairman of a group of technical advisors to the House Merchant Marine and Fisheries Committee. This spring, Dean Hollister was honored by Lehigh University with the honorary degree of Doctor of Engineering.

As a member of the class to be graduated in 1963, you are beginning five of the most important years of your life. Never before has the rapid progress of technology presented a greater challenge for engineers. Never before have the demands upon engineering colleges and individual students been so great. Each of you must assume major responsibility for the effectiveness of your engineering education at Cornell.

After you have completed fundamental courses in mathematics and science, most of your work will be centered in the buildings of the new Engineering Quadrangle nearing completion at the south end of the campus. The new buildings are designed to provide modern library, laboratory, shop, and classroom facilities essential for thorough engineering training. The pioneering five year curricula of the College of Engineering at Cornell will enable you to obtain a solid foundation in the pure and engineering sciences, and will offer an opportunity for liberal studies and an independent engineering project. The competent faculty will stimulate your progress through teaching and individual guidance. But these factors in themselves are inadequate to educate you as a Cornell engineer. Their success or failure depends on your initiative.

You are on your own in planning your use of time. Of utmost importance is the establishment of good study habits as a freshman, in preparation for the more rigorous academic requirements of the years ahead. How much you learn is directly related to how much you are willing to concentrate on comprehending theory and solving problems in order to master a subject. As engineering students, most of you will have to spend more time studying than many of your friends in other divisions of the University. The extra effort and dedication is an inescapable part of developing professional competence in engineering.

You must exercise individual initiative in asking questions of your teachers and in doing independent work. Make every effort to have your teachers clarify concepts that you do not understand. Such questions not only benefit you, but also aid the teacher in making his presentation clearer, and encourage your classmates to participate in the development of a subject. Independent work is required in obtaining the fullest value from engineering study. Some problems will require lengthy, tedious, precise solutions. Such problems are designed to acquaint you with the realities of engineering practice and to train you in the methods of accurate analysis leading to a correct answer. If you try to shortcut these problems you contribute to your own incompetence as a student and as a graduate engineer.

The role of technology in modern society places growing emphasis on quality rather than quantity of engineers and scientists. Cornell offers you a chance to cultivate the personal and technical qualities essential for a meaningful engineering career. I urge you to strive for consistent high level performance in the most important part of your Cornell life—your academic endeavor. While intellectual abilities differ among individuals, the need for the best performance an individual can give does not. The expanding role of engineering in touching every part of our way of life demands your best effort to do more than the minimum required for a passing grade. Nothing short of excellence is really adequate for the challenge you will face as tomorrow's leaders.

I wish you every success as Cornell engineering students. Your faculty and College administration are ready to help you in every possible way to make the most of your next five years. You are beginning to make an investment in yourself with far-reaching implications. That investment of five years of time, initiative, and performance can guarantee rewarding returns for yourself and society—if you are willing to cultivate a personal dedication to learn in every part of your University experience.

S. C. HOLLISTER, *Dean*

HOW NOT TO GET AN EDUCATION

by Professor William H. Erickson

Acting Director, School of Electrical Engineering

On Parents Weekend last spring I talked to a group of parents on the general theme, "JOHNNY DOESN'T TELL YOU EVERYTHING." The reaction of the parents to my informal discussion of the bad habits of some students (of which the parents were generally unaware) indicated that some interesting parent-offspring discussions would take place later that day and that the offspring would be quizzed as he had never been quizzed before.

In reviewing the points that I had discussed with the parents, it occurred to me that I had, in effect, outlined the procedures necessary to assure that the student would not reach the goal he presumably had when he entered the University, that is, an education. In addition, if a given student were to diligently apply himself to all of the nonrecommended practices, he would not have to spend four or five years training his mind but could be back out in the nonacademic world very quickly, probably after one term. Therefore, to those who wish to follow the philosophy contained in the oft-quoted - but - source - unknown - to - me statement, "An education is something we are willing to pay for and not get," this article is respectfully dedicated.

Before outlining the steps that will help the student to not get an education, I should point out that the ideas discussed are not my own but those that have been taught me by students over the years I have been in the teaching profession. These steps have been shown by actual practice to be effective—they are not untested theories.

The steps, listed in random order so that the student can apply them at his convenience, are as follows:

1. *Do only the work that is required to be turned in.* Do not study the text material assigned for the lectures or recitations because this would prepare you to understand what the professor is talking about as he expands on the material covered in the assignment. It would be well to glance over the assignment, however, because the professor may call on you to name the general area covered by the assignment. If you did not know this much, you might be excused from the classroom early while your friends remained and you would have to drink coffee at the Ivy room with a group of strangers.
2. *Try to select your electives not on the basis of what is best for you but according to failure rate, work content, and schedule.* However, finding the best combination of low failure rate, little work, and favorable schedule (no 8 o'clocks, no Saturdays, no labs, and if possible, no exams) will undoubtedly require far more effort than would an intelligent analysis of those technical and nontechnical course sequences that will prepare you for a useful professional life and a happy personal life. Too, you will probably find, with your objective, that the course you finally select to meet your specifications is not the pushover you expected it to be.
3. *Cut classes on the slightest pretext.* If an excuse is necessary, headaches are probably the best because the personnel at the clinic cannot prove that you do not have one but they can verify that you stopped there. (You may have to tell them why you did not use one of the many fast-fast-fast remedies but I will leave that story to your "ingenuity"). As you are about to cut classes do not be influenced to change your mind by those who may try to point out that each class hour is costing somebody (presumably not you and most probably your parents) anywhere from $2.50 to $12.00 in cash (depending on how you choose to calculate it) and much more in grief when you "bust out."
4. *Do not schedule your work.* By scheduling your open periods between classes in such a manner that your work is done on time it may happen that you will be able to attend one of the many evening lectures given to stimulate your mind. Also, it could happen that you would have nothing to do (you've seen the flicks and your buddies are getting ready for a prelim) and you might be forced to study to pass the time.
5. *Take an antagonistic attitude toward your professors.* When you go to lectures (assuming

he takes attendance) be prepared with the latest reading material (the Widow, the Sun, the material for the prelim the next hour), assume your slouched, awake-but-not-listening position and dare him to get through to you. Do not ever go to his office to talk to him for you may find him to be a human being with all the problems your father has (more, because he now has you) and with the facility to clear up a troublesome class point for you in a short time. There is also the possibility that he may change your attitude about not getting an education.

6. (This step is really similar to that listed as Step 5 but has to do with your advisor). *Go to see your advisor for pre-registration only after you have received your final notice* (if you do not go at all, he may schedule you for an elective that violates the principles you have set in Step 2.) Seeing him at any other time for the educational and personal advice he is able and willing to give you (and which you may easily get from an upperclassman who has your same objective but who has somehow managed to stay in school) may produce the same change in attitude mentioned in Step 5.

7. *Prepare for prelims by studying old prelims.* The purpose in this step is often misunderstood; it is not for the purpose of testing your knowledge of the subject by doing problems or answering questions that you have not seen before. Rather, you should study (and memorize) solutions to old prelims in the hope that the professor will repeat a question on the coming prelim. Care should be taken to note the original statement of the question because some numbers (or the idea) may be changed slightly and you may get the grade you really deserve. This process of preparing for a prelim should take place the night before the prelim and you should arrange to stay awake for half the night (otherwise you would have the clear head necessary for thinking through a solution. Also, this assures that none of the material will be retained, a necessity if you are to follow the policy of worrying only about the material covered since the last prelim).

8. *When prelims are returned, do not listen as the professor discusses the answers to the questions.* If you do, you may learn why you did not have the correct answer and what fundamental knowledge should have been applied. Instead, as soon as he is finished discussing these nonessential matters, ask him what the class average was on this prelim. Since you are not concerned about an education but only in staying in school, it is important that you know where you stand with respect to the class average because you feel there is safety in numbers. (You hope that a large fraction of the class has your objective and that the professor may feel that a low class average is due to a poorly prepared prelim rather than to poorly prepared students).

9. *Be content to make the good-standing average without failure.* By doing only what is necessary to stay in school, you achieve two objectives, 1) no education and 2) a sheepskin that implies that you do have an education. The second objective is important because you have the notion that all that is necessary to succeed is a piece of paper that says you have a college degree. You have the vague recollection of somebody saying that industrial employers were not concerned with grades but only with personality—and you really have worked to develop your personality. Nobody ever told you that class standing is important to many employers even in boom times and, more importantly, that progress in your chosen occupation (assuming you are able to get employment in the field of your choice) is dependent upon your analytical ability as well as upon your knowledge. It is true that students with excellent ability in their fields graduate with a relatively low class standing (according to average) but the low average is often due to the amount of time they had to spend providing their own funds for their education; it is not due to a lack of effort with regard to classroom matters. Incidentally, by just skimming by, you also assure that you will not be admitted to graduate school, a place for independent thinkers with continued education as their goal.

The steps I have listed are certainly not the only ones that may be taken to reach the objective stated but they will undoubtedly get you there. Other methods are available but they will not be discussed here; the research necessary to determine what these other methods are is left as an exercise for the student having the objective.

If you are really determined to get an education, some of the steps to follow should be obvious. However, just as for the objective for which this article was written, there are many other facets; the steps discussed here apply only to formal education. No man is ever completely educated and therefore no man can state what the complete specifications for education are. It is recognized that everything around us contributes to our education and we must each gain what we can not only from our formal classroom work but also from our bull sessions, committees, volunteer activities, concerts and the problems of our daily lives. A university provides the opportunity for a broad education but the amount absorbed depends upon the individual. I hope you are an unsaturable sponge.

ABOUT THE AUTHOR

Professor Erickson, more familiarly known to the former E.E.'s (who did not make it out the preferred way) as "The Shrewd Swede", is Acting Director of the School of Electrical Engineering. He is notorious for his basic electrical engineering courses for non-E.E.'s, 4931, 4932, and 4933.

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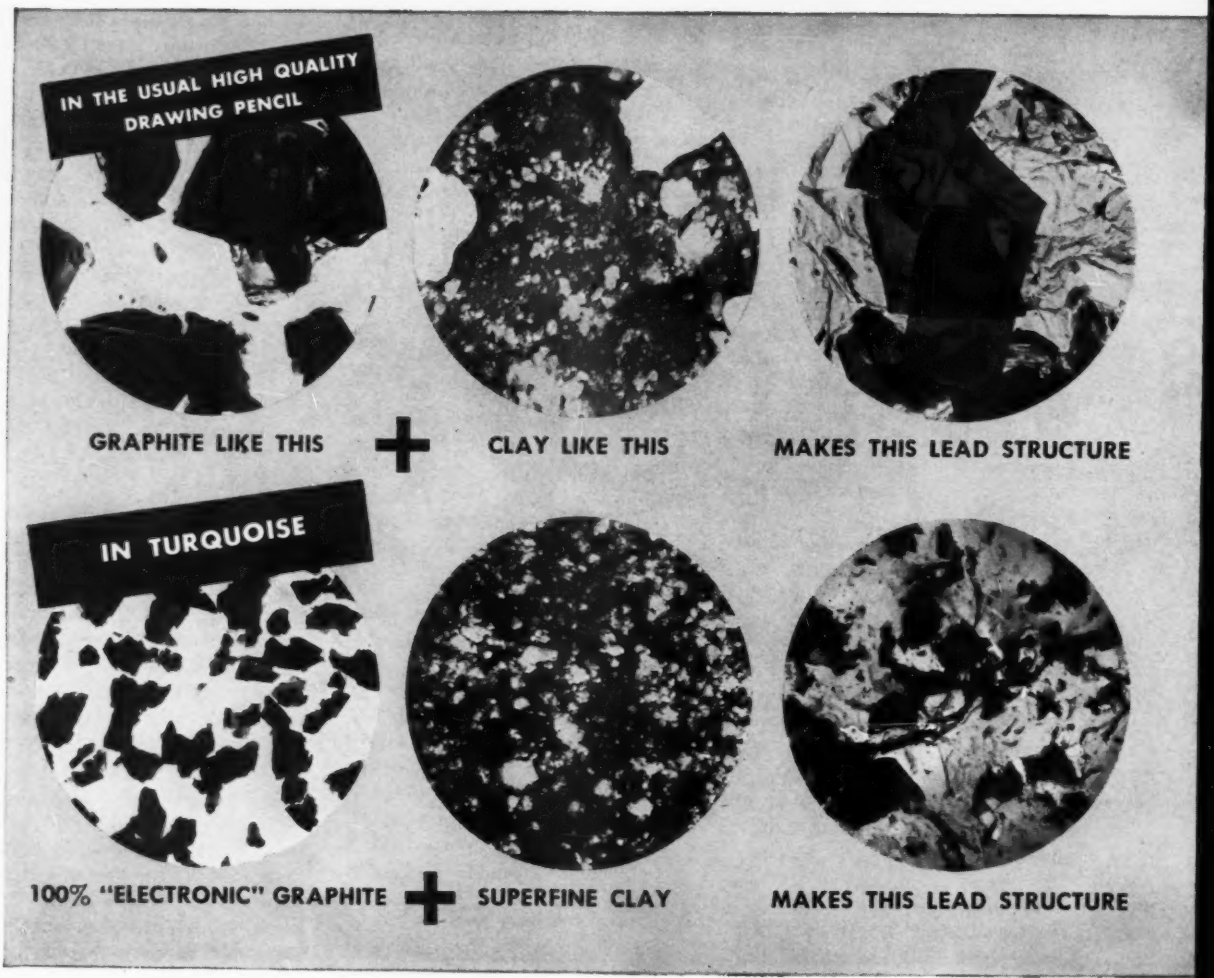

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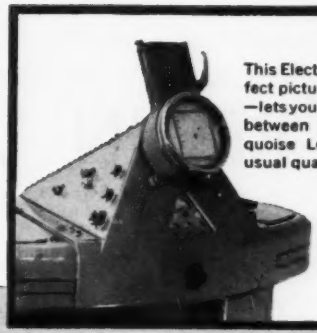

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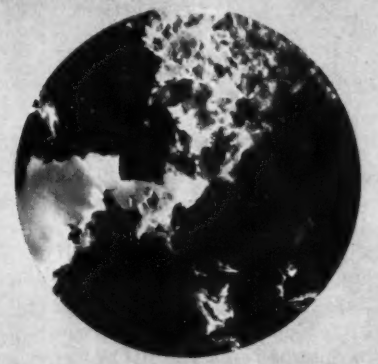

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BRAIN WAVES

by

Karl S. Menger, B.E.E. '58

In the early thirties it was discovered that the brain generates minute voltages which vary with time and which can be detected by attaching electrodes to the scalp. These generated voltages were called "brain waves," an unfortunate term possibly, since "waves" implies some sort of mental radiation into space—something which these voltage variations definitely are not.

Nor are they a pseudo-scientific explanation for extra-sensory perception, or more briefly for telepathy. If the latter phenomenon exists at all, then it is independent of distance. All electromagnetic radiation, be it light, heat, x-rays or "brain waves," decreases in strength as the square of the distance, it follows that "radiation," at least in the Maxwell sense of the term, cannot explain telepathy.

The brain-wave is then a "wave" in the same sense that commercial power is delivered as a 110-volt sine-wave. When a brain-wave is recorded graphically on paper or electronically on tape, the record is referred to as an electroencephalograph or more simply, as an EEG; a typical EEG is shown in figure 1(a). Even though EEGs are not to be confused with mental telepathy, they are creating a great deal of interest; because with proper analysis, EEGs yield information about the subject's mind which is quite similar to that of mind-reading feats—and just as astounding. Conditions such as fatigue, nervousness, state-of-shock and excitement are not only detectable from EEG analysis, but very accurately measurable quantitatively. Further interest in these wave records arises from the fact that they indicate the presence of various mental disorders such as epilepsy, as shown in figure 1(b). Whether or not they will be used in the future for probing deeper into the functionings and possibly even the thoughts of the individual mind depends largely on the success of clinical correlations and interpretations that have yet to be completed.

A German psychiatrist, Hans Berger, was the first to measure the voltages on the surface of the scalp. His equipment consisted simply of two silver wires (one attached to the subject's forehead, the other to the occiput) and a sensitive galvanometer to which these two electrodes were directly connected. With this primitive set-up, Berger was able to detect eye movements of his subject by noting changes in the galvanometer reading, as well as to detect "concentrated thinking." When the subject concentrated on solving a difficult problem, there was a sharp decrease in the normally present 10 cycle-per-second vibration of the galvanometer indicator.

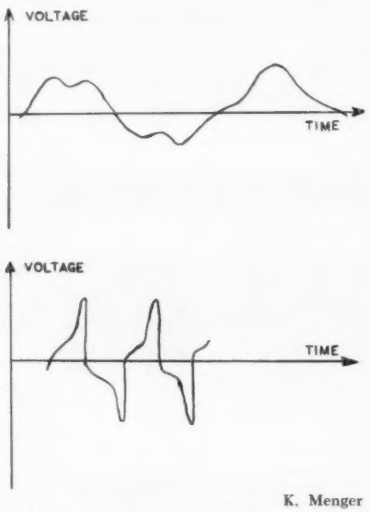


Figure 1: a. (top) typical EEG
b. (bottom) EEG of an epileptic

Basic Principles

On the basis of these early observations, certain basic assertions concerning the electrical nature of all living plant and animal cells were formulated. These assertions stated in essence that various electrical activity is associated with all cells and if the cell activity changes, the electrical activity will likewise change; conversely, if the electrical activity is varied, the cell activity will vary correspondingly. The final assertion, which has now become part of the basis for modern mathematical EEG analysis, stated that living tissue can be represented as a complex electrical impedance network consisting of linear resistors and capacitors. A typical value for tissue resistance is 100 ohms/cm^3. While a typical value for surface capacity is 1 mfd/cm^2.

Careful mapping of the scalp, similar to the field mapping of electrode configurations in vacuum tube study, has indicated that the head, electrically speaking, is a dipole with an axis which comes to the surface at the forehead. In general, the EEG voltage increases with increased electrode separation.

Electronic equipment, permitting far more accurate measurements than Berger's original galvanometer

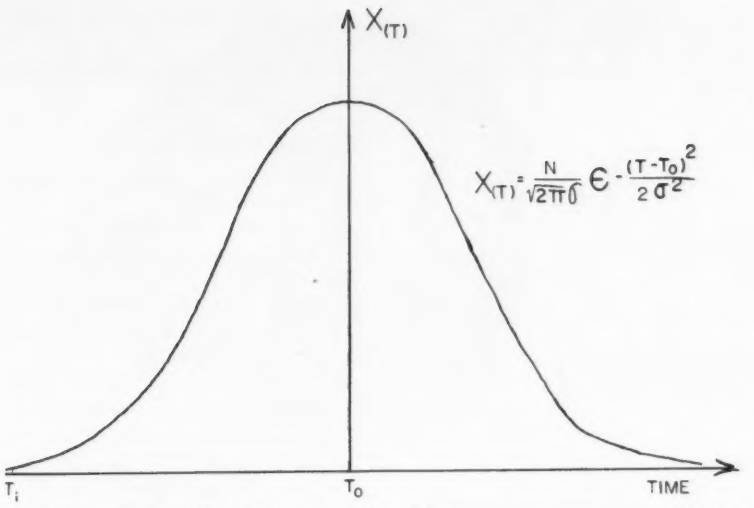


Figure 2: T_i = time of application of stimulus K. Menger
T_o = time at which 50% of the total neuron population has fired.
N = Area under the curve = Total number of neurons in the population

was capable of making, has been used to determine the precise values of amplitude and frequency that characterize these scalpal voltage variations. The two parameters change continually with time, in tune with the mental changes of the subject. However, the base frequency is rarely less than 0.5 or greater than 100 cycles-per-second; the amplitudes are of the order of 1.0 millivolt and vary inversely with brain activity. The voltage changes brought about by the brain must be separated from the changes due to variations in skin resistance as well as voltages generated by eye movements, heart beat and neck muscles. Unless the probes are placed properly and the subject held stationary, these stray effects will also appear on the EEG, rendering the record useless.

Up until recently, EEGs have been treated by Fourier analysis. In other words, the graphs have been broken up into sine-wave components (either graphically or electronically) and the amplitudes of these harmonics have been correlated with known clinical conditions of the subjects. As an illustration of this procedure, it may be found that all subjects who are suffering from excessive nervousness such as stage fright, also show an unusually large amount of third harmonic in their EEGs. This sort of analysis tacitly assumes that the brain, electrically, consists of a series of sine-wave voltage generators of various amplitudes, frequencies, and phase shifts, and that the output EEG voltage is the sum of the individual generators. There is, however, no physiological basis for assuming that the brain functions in terms of sine-wave rhythms; and in fact, clinical correlations on mentally normal subjects based on Fourier analysis have proved unreliable. For this reason, a new mathematical basis for analyzing the EEG records was recently sought. To obtain this new approach, a closer look was given to the exact cause of these scalp potentials.

Neurons Cause Scalp Voltages

Without going into the biophysics to any great extent, it should be mentioned that the potentials arise from the electrical activity of nerve cells in the brain referred to as neurons. Neurons, as do all other nerve cells, change their electronic charge distribution when stimulated and thereby cause corresponding voltage fluctuations. After a given stimulation there will be a few neurons which will change their charge distribution (or fire) almost immediately; a few others will fire after a relatively long time delay, while the majority will fire in some statistical distribution between these two extremes. Neurons behave as if they were packaged into groups referred to more commonly as "populations"; these populations react independently of each other to the stimulations arriving at the brain. The number of firing neurons as a function of time, $X_{(t)}$, is plotted in figure 2 for a typical population that has been stimulated initially at time, T_i.

Making use of the basic assertion mentioned earlier, concerning the network representation of living tissue, the equivalent circuit of the brain area can be reduced to the simple configuration shown in figure 3. Z_1 and Z_2 are both linear impedances since they are built up of only linear resistances and capacitances. The summation of the internal voltage sources originating from the activity of each neuron population is represented by $\Sigma X_{(t)}$ (if there are k populations, the $\Sigma X_{(t)}$ is the total voltage of k sources in series).

It becomes apparent then that the brain can be considered as consisting of normal-distribution voltage sources rather than sine-wave sources as originally assumed. Referring to figure 3 again, $E_{(t)}$ is the external or output voltage, in other words the measurable EEG signal. This potential may be expressed by the following series:

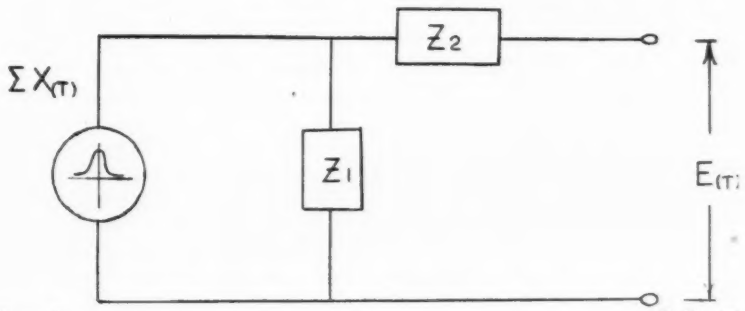
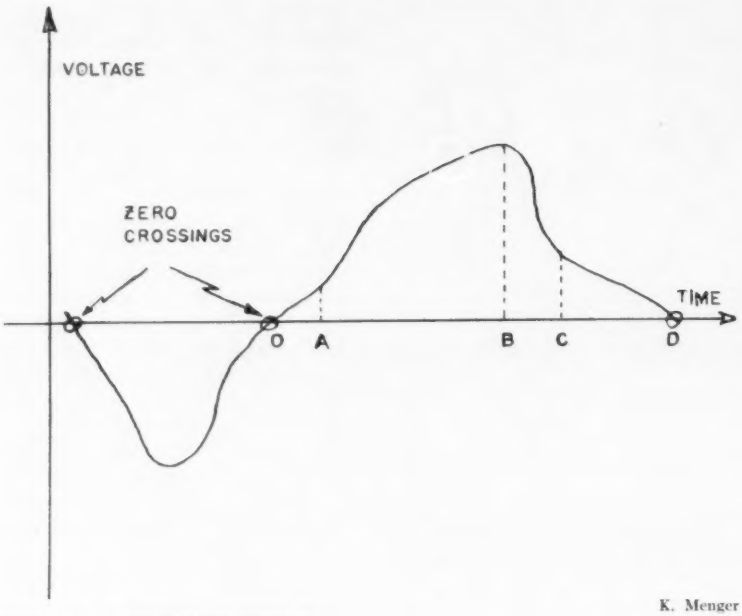


Figure 3: K. Menger
$\Sigma X_{(T)}$ = normal distribution voltage from the brain
Z_1, Z_2, = linear impedances composed of linear resistors and capacitors
$E_{(T)}$ = measurable EEG signal



K. Menger

Figure 4: O, D are adjacent crossings
A, C are times for which $\frac{d^2E}{dt^2}=0$ **B is time for which $\frac{dE}{dt}=0$**

$$E_{(t)} = A_n \frac{d^nX}{dt^n} + A_{n-1} \frac{d^{n-1}X}{dt^{n-1}} + \ldots A_1 \frac{dX}{dt} + A_0X$$

where A_n, A_{n-1}, . . . A_1 and A_0 are all constants owing to the linearity of the two impedances; the magnitude of n depends on the complexity of these same two impedances. This summation of "n" time derivatives in "X" plus the distribution function "X" itself is referred to in mathematical circles as the Gram-Charlier Series. There is one such Series for each of the k neuron populations and the total EEG voltage is therefore the sum of these k Series each containing n+1 terms.

As an approximation to this cumbersome expression for the EEG potential, the following form for the signal is assumed:

$$E_{(t)} \simeq \frac{1}{\sqrt{2\pi}\,\sigma} \epsilon^{-\frac{t^2}{2\sigma^2}} \left(1 - B\frac{t}{\sigma^2}\right)$$

where σ is proportional to the time spread of a given half-wave on the EEG, and where B is a measure of half-wave symmetry:

B=O, the half-wave is symmetrical

B>O, the half-wave is skewed to the right

B<O, the half-wave is skewed to the left.

Therefore, rather than decomposing the EEGs into various sine-wave components as has been done up to this time, it appears more logical to decompose the EEG into σ's and B's. These two parameters could theoretically be obtained from the EEG by taking measurements at the points in time where:

the EEG changes sign (using the average value as a zero reference)

the EEG reaches a relative maximum or minimum value, and

the slope of the EEG reaches a relative maximum or minimum value.

In practice, however, making use of this zero-crossing data to obtain σ and B would require, in addition to summing equipment, four high-speed multipliers and one divider; and would require even with this equipment, the same amount of time needed to process the EEG manually. For this reason, a slightly different set of constants are defined and studied for clinical significance. The new constants have the advantage of all being derivable directly from the zero-crossings of the EEG and its first two time derivatives. Included among these constants are, referring to figure 4:

(1) Range, the time interval between adjacent zeros = d

(2) First order symmetry = d − 2b

(3) Left side deviation coefficient = b − a

(4) Right side deviation coefficient = c − b

(5) Second order assymetry measure = c − a

The Brain Wave Analyzer

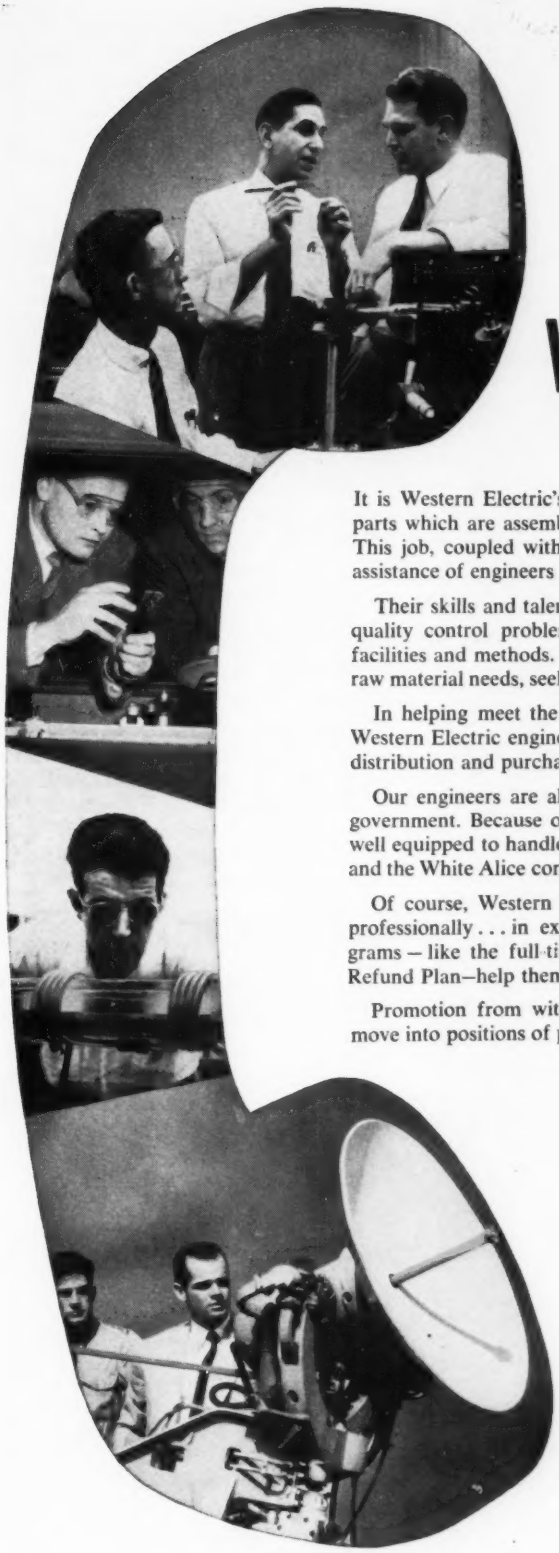
Although the specific circuitry which was designed to measure the above constants continually and automatically is beyond the scope of this article, a general statement can be made about the overall operation of the analyzer built recently by American Machine & Foundry. The EEG voltage is amplified and differentiated twice with respect to time; these three voltage signals are then detected for zero-crossings, and the above constants are then derived by an analogue computer and displayed directly on ordinary meter movements.

The patient may be connected directly to the Brain Wave Analyzer; however, the usual procedure is to record the subject's signals with an ordinary tape recorder and then to play this back into the Analyzer. The hypothetical stage-fright case would now be detected by, say, an unusually high ratio of left to right side deviation coefficients (constants (3) and (4) above) as read straight from the meter panels.

The electronic amplifiers used to magnify the EEG voltage must be designed to handle the low frequency content of the signal. Where resistance-capacitance coupling is used in the conventional inter-stage connection, a time-constant of about one second is required. With this time-constant, typical values for the resistor and capacitor become one megohm and one micro-farad respectively. The oversized capacitor resulting from this abnormally large time constant introduces a further problem, that of blocking. Blocking refers to a condition where the tube is unable to pass plate current which occurs while the capacitor is initially discharging through the grid resistance. During this period then, the tube is cut off and consequently no signal amplification can be obtained.

Another one of the more critical limitations in amplifier design for EEG signals is connected with the balanced input requirement. Neither of the two scalp electrodes

(Continued on page 69)



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Our engineers are also deeply involved in defense projects entrusted to us by the government. Because of our specialized experience as part of the Bell System we are well equipped to handle the job. Among these projects: the Nike guided missile system and the White Alice communications network in Alaska.

Of course, Western Electric engineers are encouraged and assisted in developing professionally . . . in expanding their technical know-how. Company-sponsored programs — like the full-time Graduate Engineering Training Program and the Tuition Refund Plan—help them along.

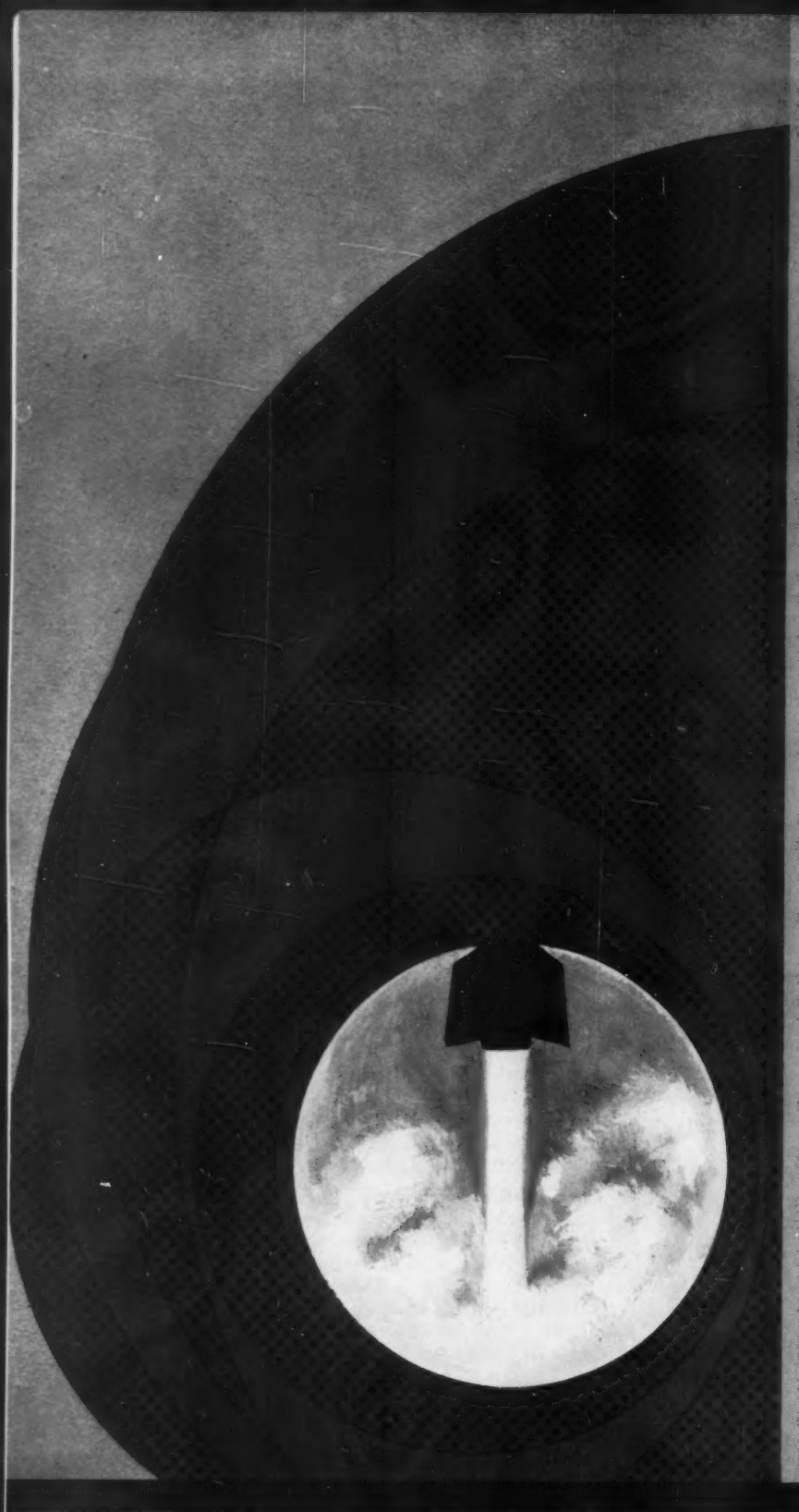
Promotion from within—a Western Electric policy—helps many of our engineers move into positions of prime responsibility. Today, 55% of the college graduates in our upper levels of management have engineering degrees. In the next ten years, 7,000 key jobs must be filled by newly promoted people—engineers included.

Western Electric technical fields include mechanical, electrical, chemical and civil engineering, plus the physical sciences. For more information pick up a copy of "Consider a Career at Western Electric" from your Placement Officer. Or write College Relations, Room 1111D, Western Electric Company, 195 Broadway, New York 7, N. Y. And sign up for a Western Electric interview when the Bell System Interviewing Team visits your campus.

Western Electric

MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM

Principal manufacturing locations at Chicago, Ill.; Kearny, N. J.; Baltimore, Md.; Indianapolis, Ind.; Allentown and Laureldale, Pa.; Burlington, Greensboro and Winston-Salem, N. C.; Buffalo, N. Y.; North Andover, Mass.; Lincoln and Omaha, Neb.; Kansas City, Mo.; Columbus, Ohio; Oklahoma City, Okla., and Teletype Corporation, Chicago 14, Ill. and Little Rock, Ark. Also Western Electric Distribution Centers in 32 cities and Installation headquarters in 16 cities. General headquarters: 195 Broadway, New York 7, N. Y.



ACOUSTIC NOISE

When huge rocket engines lift a ballistic missile or satellite vehicle into the air, the thundering noise of the engines violently shakes intricate electronic components and the missile structure itself. Acoustic noise is one of the many environments that must be thoroughly explored and understood by the missile designer.

But it is expensive and impractical to conduct acoustic noise tests by operating rocket engines on the ground. Noise—of the same frequencies and amplitudes as rocket engine noise—must be produced in the laboratory.

Engineers at Avco's Research and Advanced Development Division have met this problem by designing a versatile high-intensity acoustic noise generator. Based on electromagnetic principles, it creates noise environments of the same frequency spectra as rocket or jet engines.

This successful effort is now part of the division's complete environmental testing laboratory, where it is producing information for Avco scientists and engineers responsible for ICBM nose cones.

Acoustic noise work is one of the many development programs that proceed simultaneously with theoretical and applied research at RAD. The mutual stimulation of scientists and engineers in many disciplines occurs naturally at Avco, where the search for new knowledge and its application go forward under one roof.

Research and Advanced Development is more than a descriptive title at Avco. It is a concept that promotes creativity.

Avco

Research and Advanced Development division

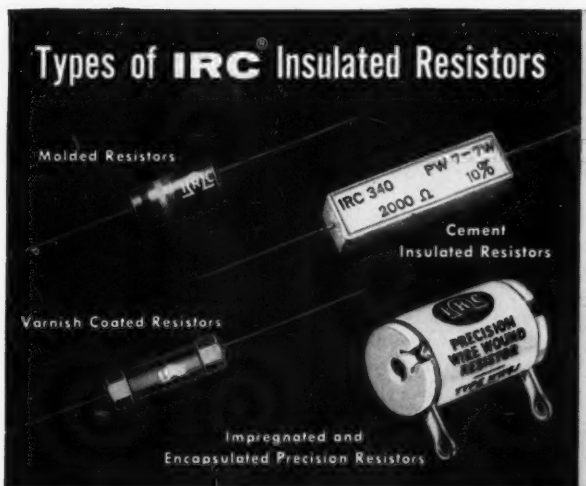
For information on unusual career opportunities for exceptionally qualified scientists and engineers, write to: Dr. R. W. Johnston, Scientific and Technical Relations, Avco Research and Advanced Development Div., 201 Lowell Street, Wilmington, Mass.

Specially-compounded coatings and housings enable IRC resistors to withstand a higher degree of impact, shock and vibration than any other resistors of their type.

The skillful combination of protective coatings and resistive elements assures superior moisture resistance and heat dissipation, as well as protection from severe humidity or temperature conditions.

Exactly how important are resistor insulations?

In a sense, a resistor is simply a mechanical device for packaging ohms. So it is easy to see why the materials making up the mechanical package greatly determine resistor performance. In fact, insulation is so important that more than one-third of the 200 technicians at IRC are engaged in developing custom-tailored insulating coatings and housings for IRC resistors. That's why every IRC resistor is better protected from damage and ambient conditions than any other of its type. And at no extra cost.



ENGINEERING POSITIONS

IRC, leader in resistor engineering, offers excellent opportunities in engineering positions covering many professional fields. New developments in electronics, miniaturization and automation constantly present new creative challenges. For information, write today to: ENGINEERING EMPLOYMENT, INTERNATIONAL RESISTANCE COMPANY, 401 N. Broad St., Philadelphia 8, Pa.

INTERNATIONAL RESISTANCE CO.

401 N. Broad St., Philadelphia 8, Pa.

In Canada: International Resistance Co., Ltd., Toronto Licensee

Wherever the Circuit Says IRC®

CORNELL SOCIETY OF ENGINEERS

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students, and to establish closer relationship between the College and its alumni."

Roscoe H. Fuller

THE PRESIDENT'S MESSAGE—

As the new scholastic year gets under way, and your Society embarks upon its 1958-9 fiscal year, it is gratifying to report on the returns already received as a result of the "Annual Letter" which went out in July to all engineering alumni whose addresses are known to the University.

Several hundred dues were received within the first month, in spite of summer vacations, and the rate is on the increase. Did you mail yours yet? A check for $3.00 with your name and address will take care of the formalities in case you have misplaced the membership card. The acceptances of a year's free membership by the June graduates indicate a continuing interest in their college which it is pleasant to see. Our hope is, of course, that the entire class will sign up. Early returns indicate that the response will be high.

In spite of the assurance that our Annual Letter was not intended as a solicitation, several alumni felt impelled to send in sizable contributions to the Engineering Development Fund with their dues. That sort of voluntary response we should like to think of as typical of the Cornell alumnus. Having seen the need, to immediately do what you can to fill it is in the best tradition of alumni loyalty. Of such stuff is a great University made.

To those who thus acted, without waiting for solicitation, I should like publicly to extend thanks on behalf of the College as well as the Society.

By the time this appears in print a new crop of freshmen will have been matriculated, oriented, indoctrinated, and slightly confused. Probably out of the confusion is beginning to emerge the suspicion that there is a certain amount of work involved in obtaining an Engineering degree, and that the Cornell tradition of freedom with responsibility presents a somewhat different climate from the usual secondary school.

That there is no better climate for learning is the considered conviction of faculty and administration, as well as those of us who have long since graduated. But it imposes a burden which can be neglected only at considerable cost. By way of illustration let me cite the old problem, one variant of which goes like this:

> If two vehicles start at the same time for a destination 60 miles away, one travelling at 60 miles per hour and the other at 30 miles per hour: When the second vehicle has gone half the distance to the destination, how fast would it have to travel the remainder of the way to arrive at the same time as the first vehicle?

If the example bears any analogy to the pursuit of a college career and the terms of speed may be likened to degrees of diligence, the moral may be obvious.

Careful budgeting of one's time and effort appears to be the answer, and although no courses will be found in the curriculum which teach this, it is an ability which will be found of the greatest value throughout any career.

So welcome, freshmen. We are glad that you have chosen our University. The processes of selection which were involved in your being admitted are designed to insure that you show exceptional promise and that in after years you will be a credit to your university and your profession. We hope and believe that you will.

ROSCOE H. FULLER

ALUMNI ENGINEERS

The Cornell University Alumni Association announced the results of its recent election in which three members were elected to the Board of Trustees of the University.

Leroy R. Grumman, '16, Chairman of the Board of the Grumman Aircraft Engineering Corporation, Bethpage, L.I., N.Y., was re-elected for a five year term. **Fred H. Rhodes, Ph.D. '14,** founder and retired Director of the School of Chemical and Metallurgical Engineering at Cornell, was elected for a five year term. **Dr. Preston A. Wade, '22,** Professor of Clinical Surgery at Cornell University Medical College, and a former trustee, was elected for one year, to fill out the unexpired term of the late **Dexter S. Kimball, Jr., '27.**

The University charter provides for a Board of Trustees of 49 members. Ten are ex-officio trustees, 22 are elected by the Board: 15 members at large for five year terms, four from the University faculty for five year terms, and three "from the field of labor in New York State" for one-year terms; ten are elected by the alumni for five year terms; five are appointed by the Governor for five year terms; one is elected annually by the New York State Grange; and the eldest lineal descendant of Ezra Cornell is a trustee for life.

Joseph C. Delibert, CE '36, has been made an administrative assistant to the president of the Babcock & Wilcox Company. Mr. Delibert's duties will be concerned with general administrative details and special assignments from the president.

Joseph C. Delibert

Mr. Delibert joined B&W's marine engineering department in Barberton, Ohio, in 1936, as stress analyst. One year later, he was transferred to New York, where he was employed in marine boiler design and sales. He moved to the advertising department in 1946 and was made assistant manager in 1955. Two years later, he transferred to the sales department of the boiler division as promotion and training manager.

While with the marine department, Mr. Delibert worked on a number of special assignments, including Mercury Boilers, land and sea tests for Steamotive Boilers and the company's merchant and naval boiler programs during World War II. He also is the author of "Fighting Hearts of Fighting Ships," a history of B&W's participation in the last world-wide conflict, and of various technical articles on boilers and steam generation.

A recipient of a Fuertes Medal for scholastic achievement at Cornell, Mr. Delibert is a member of the Cornell Club of New York, the American Society of Mechanical Engineers, the Engineers Club, and Tau Beta Pi and Chi Epsilon, both honorary engineering societies.

Frederick F. Wood, CE '33, has been elected Assistant to the Vice-President of The International Nickel Company of Canada, Limited, and Assistant Vice-President of the company's United States subsidiary, The International Nickel Company, Inc.

Mr. Wood has been Assistant to the Vice-President of the U.S. subsidiary since May, 1955. He has supervised that company's corporate advertising and industrial publicity since 1947, and directed its motion picture activities since August, 1950. In his new duties Mr. Wood will oversee and be responsible for co-ordinating all publicity and advertising activities for the company and subsidiaries.

Frederick F. Wood

Joining International Nickel's U.S. subsidiary in 1934, Mr. Wood served first in the Accounting and Production Departments at the New York office, and subsequently at the company's Bayonne, N.J., Works. Before returning to the New York office as a member of the Sales Department, Mr. Wood was with Whitehead Metal Products Company, Inc., an Inco affiliate. Following active duty with the U.S. Navy during World War II, he was appointed Executive Assistant in 1945. In 1955, Mr. Wood was elected Assistant to the Vice-President of The International Nickel Company, Inc.

He is a director of Whitehead Metal Products Company, Inc., and a member of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Cornell Engineers Club, University Club, New York, and the Patterson Club, Westport, Connecticut.

Robert G. Clark, ME '21, is vice-president in charge of manufacturing for Utah Oil Refining Co. Mr. Clark joined the company as a draftsman back in 1922 and later became chief engineer. Before his promotion he was refinery manager and a director.

Lawrence T. Deabler, EE '50, has been named manager of engineering education for IBM in Poughkeepsie. He is in charge of all laboratory training programs, professional orientation, and the Syracuse University graduate program.

Which of the following are practical applications of COPPER or COPPER ALLOYS?

- ☐ 1. Ship fittings.
- ☐ 2. Television antennae.
- ☐ 3. Heat sinks for missile nose cones.
- ☐ 4. Architectural extrusions.
- ☐ 5. Prefabricated plumbing lines.
- ☐ 6. Pipelines for sodium hydroxide.
- ☐ 7. Collector vanes for solar heating.
- ☐ 8. Resistance heating elements.
- ☐ 9. Resistance-welding electrodes.
- ☐ 10. Gold-plated jewelry.

Now try your hand at these True-False Selections:

- ☐ 11. Proved copper reserves have decreased in the last 20 years. ☐T, ☐F.
- ☐ 12. On the machinability rating scale, Free-Cutting Brass rates 100. ☐T, ☐F.
- ☐ 13. The green patina of copper can be developed artificially. ☐T, ☐F.
- ☐ 14. Copper and copper alloy parts should be joined only by riveting. ☐T, ☐F.
- ☐ 15. Nickel Silver is an alloy of nickel and silver. ☐T, ☐F.

1. Yes. Copper, and many of its alloys, have excellent resistance to salt water corrosion.

2. No. The important properties of copper are not needed and lighter, cheaper metals are usually used.

3. Yes. Copper's high heat conductivity protects the delicate instruments inside by quickly dissipating the surface heat of re-entry.

4. Yes. Architectural bronze extrudes readily and is used for a wide variety of architectural shapes.

5. Yes. Because copper tubing can be easily and firmly soldered, it lends itself well to prefabrication. The few unassembled joints are soldered on the site, eliminating the use of threaded fittings.

6. Yes. Copper-nickel alloys have good resistance to many alkalies and are often used in contact with them.

7. Yes. Large vanes of copper are blackened and mounted on a roof to collect the sun's rays. The high thermal conductivity of copper makes it very efficient for this use. The copper carries the heat to a circulating water system.

8. No. The conductivity of copper and its alloys is too high for this purpose.

9. **Yes.** Here the current is introduced through the electrodes to the parts to be welded. Several copper alloys are well suited for this use because of their high strength at elevated temperatures.

10. **Yes.** The low-zinc brasses are easily worked and are readily plated for high-quality costume jewelry. Most copper alloys lend themselves well to polishing and plating.

11. **False.** Reserves have increased. Published figures are no indication of long run availability or total mineral deposits. The industry lists only those reserves which have been "proved" for immediate development. Since the copper industry has grown in these years, so, too, have the proved reserves. Future copper supplies are vastly greater than any known "reserve" figures would indicate.

12. **True.** Free-Cutting Brass usually can be turned at maximum spindle speed and many other copper alloys at high speeds. A large number of copper alloys are available for easy machining.

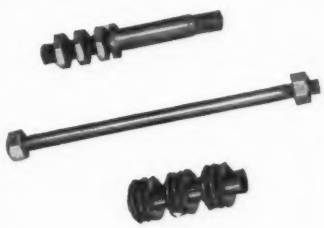
13. **True.** The Copper & Brass Research Association has developed a spray process which has been successfully used to give architectural and ornamental parts an attractive green patina much faster than nature would do it.

14. **False.** Good joints between copper or copper alloy parts can be made by soldering, brazing or welding.

15. **False.** The Nickel Silvers are copper alloys. They derive their name from their silver-like color. A typical composition is 65% copper, 18% nickel, 17% zinc, and no silver at all.

The copper alloys, of which there are more than forty that are standard and many more that are special in current use, have many properties just as unique as this "silver" that isn't silver. If you'd like to learn more about them, or if you really flunked this quiz, send for your copy of "A Guide to Copper and its Alloys." The Copper & Brass Research Association, 420 Lexington Avenue, New York 17, N. Y., will be happy to supply it.

World's Biggest Eater Dines Without Interruption



Typical insulator and insulating bolts used on power shovels.

You are looking at 3 million dollars' worth of power shovel, a 14-story monster capable of biting off 70 cubic yards of dirt at a clip.

Continuous operation is essential because downtime on a shovel of this size could top 500 dollars an hour. Reliability is shared by many interrelated parts. Some are made of Synthane laminated plastics.

Why Synthane? Because Synthane laminated plastics have the right combination of properties—dielectric strength, mechanical strength, and ease of machining. And Synthane uses only first-quality raw materials, watches every step in the production and fabrication of the laminate, is deeply concerned about delivery requirements.

Good materials, competent people, excellent tools and workmanship may not guarantee reliability but they're strong assurance of it.

If you are interested in a reliable source of laminated plastics—sheets, rods, tubes, or completely fabricated parts, write for an interesting catalog or call our representative near you.

SYNTHANE

SYNTHANE CORPORATION, 13 RIVER RD., OAKS, PA.

TECHNIBRIEFS

MEDICAL DATA TRANSMITTED BY RADIO AND TELEPHONE

A new achievement which would permit physiological information to be transmitted over long distances by radio or telephone has been developed at the Naval Medical Research Institute, Bethesda, Maryland.

Such information as heartbeat, breath sound, spoken words and other measurements of the physical condition of humans or animals, can be transmitted from isolated areas to Bethesda.

This is accomplished by utilizing the electrical impulses generated in the body and by converting other measurements such as body temperature and respiratory volume into electrical equivalents. The electrical phenomena are taken from the body by means of suitable electrodes. These and the electrical equivalents of other measurements are amplified as required and caused to modulate an oscillator or a radio transmitter. The impulses are then transmitted over radio or telephone circuits to Bethesda, where the signal is converted back to the original form it had in the subject's body. It is then portrayed on oscilliscopes, direct writers, and audio systems. At the same time the data is recorded on magnetic tape to provide a permanent record.

This achievement is expected to contribute significantly to the scientific and medical professions. Information could be forwarded from isolated medical practitioners and small clinics in need of the services of medical specialists available only in large cities. Through the transmittal of the essential information by telephone, the specialist can hear the heart murmurs, watch the pulse pressures and have the whole examination episode recreated in his office. If the consultant is unavailable at the time, the information recorded on tape, is on hand at his convenience.

Also, through this system, it will be possible to obtain the measurements of the physical condition of future animal and human occupants of space vehicles. Information could be relayed from pick-up stations in remote parts of the world to the Naval Medical Research Institute at Bethesda over the Navy's world wide communications network, and over commercial radio and telephone circuits.

CANNED GRAPHITE PUTS BRAKES ON NEUTRONS

Neutrons speed from a split uranium atom at approximately 6,000 miles a second, and must be slowed down to about one mile a second if fission is to be properly sustained. High purity graphite has proved to be one of the best materials with no practical melting point, so it is unaffected by extremely high temperatures. It can be easily machined into intricate shapes, as can be seen in the photograph where hexagonal columns of graphite, sealed in zirconium cans, are being installed in the reactor core tank of the first non-military nuclear reactor to produce commercially distributed electricity.

Designed and built by Atomics International for the U.S. Atomic Energy Commission, the sodium-cooled, graphite-moderated reactor is part of the AEC's program to develop basic technology for economical nuclear power plants. Graphite columns also serve in the reactor as a reflector, scattering the neutrons and directing some back into the core, permitting increased power output from a given mass of fissionable fuel.

Graphite columns are being installed in a nuclear reactor to slow down and control nuclear velocity.

The accurately machined graphite was enclosed in zirconium to prevent the liquid sodium, used as a cooling medium, from penetrating its pores and being absorbed. This would then result in the absorption of neutrons by the sodium in the graphite, and the eventual reduction of the chain reaction. Power produced by the reactor operates nearby generators of Southern California Edison Company, which can produce as much as 6,500 kilowatts of electrical energy.

MACHINE CAPABLE OF TEACHING SELF OPENS IMMENSE FIELDS

The concept of the first non-biological system capable of perceiving, recognizing and identifying its surroundings without any human training or control, has been successfully demonstrated and proven by Dr. Frank Rosenblatt, research psychologist at the Cornell Aeronautical Laboratory, Inc. of Buffalo, N.Y., under contract for the Office of Naval Research at Washington, D.C.

The "Perceptron" system has been effectively simulated on a conventional IBM 704 computer many times, in each case demonstrating the ability not only to "learn" what it is "shown," but also an uncanny capability of spontaneously "teaching itself" to recognize something, and then indicate what that particular something is, even though it has never "seen it before."

After being shown, or stimulated with, 100 squares located at random on either the left side or the right side of a rectangular visual field, the simulated "Perceptron" firmly associated one group of stimuli with "left," and the other group of stimuli with "right." This result was achieved with 97% consistency at the end of 100 trials, and it was evident that the "Per-

ceptron" system had "learned" to recognize the difference between left and right after it had "seen" only 30 to 40 stimuli.

The ultimate applications of this new system are almost fantastic to conjure with and yet, in principle, such things as reading print and script, as well as responding to verbal commands, are within reach. And, only one step beyond the level which now appears attainable by the "Perceptron" lies the possibility of an automatic translator, which can receive spoken inputs in one language, and produce written or verbal outputs in another language.

"Perceptron" is described in the Navy announcement as being unique in several respects. The system does not recognize forms, shapes or other items by matching them against a stored inventory of similar images previously fed into it by an operator, nor by performing a mathematical analysis of characteristics. Instead, the recognition is direct, and essentially instantaneous, since the association by which a perceived stimulus is identified is derived in the form of new pathways through the system, rather than from a coded representation of the original stimulus. This is much like a man who gets a direct view of an object through his eyes, from which impulses flow through his nervous system to the brain, in turn enabling him to instantly recognize and identify that object for someone else.

As a model for the biological brain, the "Perceptron" does not violate any known information about man's central nervous system. Its size, the logic of its connections, the degree of reliability required of individual units, the permissible random variation in its "wiring diagram" and the kinds of signals employed, are all consistent with known anatomical and physiological data relating to the processes of the human mind.

The "Perceptron" appears to be the first and only electronic concept which has the proven inherent capability of spontaneous organization and symbolization of its own environment along lines which bear some definite relationship to the human concept of "similarity," although other statistical systems have been previously proposed which might be implemented by a digital computer. This is in marked and greatly advanced contrast to the execution of a logical program which has been previously fed into the conventional electronic computers we use nowadays.

LOW TEMPERATURE, RESISTANCE THERMOMETER DEVELOPED

A germanium resistance thermometer having high sensitivity and exceptional stability in the temperature range near absolute zero has been developed by Bell Telephone Laboratories. Once calibrated, this thermometer is reproducible to better than a few ten thousandths of a degree at the boiling point of helium (4.2°K) even after repeated cycling from room temperature. Such characteristics indicate that this thermometer might be useful for the accurate measurement of temperatures in outer space, when mounted in a suitable space vehicle.

Continued emphasis on low-temperature research has highlighted the need for a thermometer which would indicate low temperatures accurately and reliably, and would not need continued recalibration. Such a device would be of great help in low-temperature calorimetric work. The germanium resistance thermometer meets these specifications.

The heart of this thermometer is a very small "bridge" cut from a single crystal of arsenic-doped germanium. The actual size of this bridge is about 0.025" x 0.020" x 0.210". Current and potential leads are attached to the bridge, and it is supported in a strain-free manner in a platinum-glass enclosure containing a small amount of helium gas to aid in thermal conduction. The resistance is determined by measuring the potential drop when a small (approximately 10 microamperes) known current is passed through the bridge.

Germanium can be doped with arsenic to produce a high and fairly constant temperature coefficient of resistance at temperatures near the boiling point of helium. For example, a typical thermometer had a resistance of about one ohm at room temperature, 14 ohms at 10°K and 216 ohms at 2°K. Both the temperature coefficient and the actual resistance vary widely with minute changes in the amount of doping, making it possible to fabricate a thermometer having any of a wide range of characteristics. Such a thermometer will retain its calibration despite repeated cycling from 300°K to 1°K.

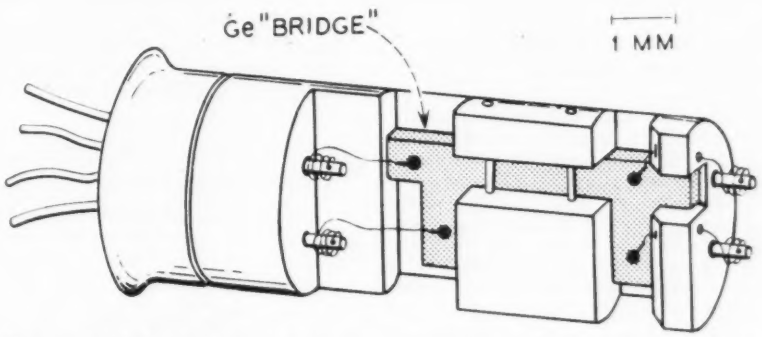
To avoid excessive heating when measurements are being made, the resistance of the thermometer should be kept as large as possible. However, for simplicity in measurements, a low resistance is desirable. For a specific application, a compromise can be reached by controlling the doping of the germanium crystal.

ARTIFICIAL QUIET CREATED BY NEW ELECTRONIC EARPHONES

Development of an experimental electronic earphone, considered a major breakthrough in noise reduction and designed to create artificial quiet by shutting out loud noises that interfere with combat communications was announced by the Department of the Army.

Scientists created the artificial quiet by adding more noise with a

(Continued on page 69)



Cross-sectional drawing shows the internal construction of the germanium resistance thermometer.

Mars Pencils Sponsors Tomorrow's Designs

MARS OUTSTANDING DESIGN SERIES—featured in the current advertising of J. S. Staedtler, Inc.—has attracted widespread attention among the users of fine drafting pencils. It has fulfilled our expectation that the men who appreciate the finest working tools are those with a lively creative interest in new designs, new projects, new ideas.

Concerned with unusual projects—*designs of the future*—Mars Outstanding Design Series provides a "showcase" for originality, for interesting work of engineers, architects, and students which so often lies buried. To stimulate you to send in *your* designs, Mars Pencils

will pay you $100

for any design accepted. This $100 is paid you simply for the right to reproduce your project in the Mars Outstanding Design Series. There are no strings attached. You will be given full credit. (See ad on this page—one of the ads in the current series.) All future rights to the design remain with you. You can reproduce it later wherever you like and sell or dispose of it as you wish.

The subject can be almost anything—aviation, space travel, autos, trains, buildings, engineering structures, household items, tools, machines, business equipment, etc. It should be a project that appeals to design-minded readers, be of broad interest, and be attractively presented. Do not submit a design that has been executed. As a matter of fact, the project does not need to have been planned for actual execution. It should, however, be something that is either feasible at present or a logical extension of current trends. It cannot be unrealistic or involve purely hypothetical alterations of natural laws.

There is no deadline for entries but the sooner you send yours in, the greater the probability of its use as one of the subjects in the 1959 Mars Outstanding Design Series.

It Is Simple To Submit a Design For Mars Outstanding Design Series

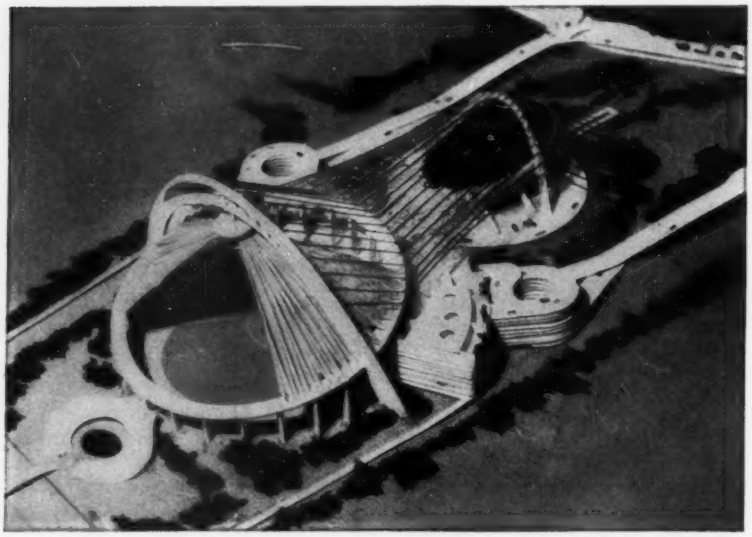
Just mail in an inexpensive photostat or photocopy of the subject—one you can spare, since it cannot be returned.

If your entry is accepted, we will ask you to send in a sharp photograph of the design, or the design itself, so that we can make a sharp photograph suitable for reproduction—after which it will be returned to you promptly.

Send your entry to:

J.S. STAEDTLER, INC.
DICAROLIS COURT, HACKENSACK, NEW JERSEY

MARS outstanding design **SERIES**



umbrella'd stadia

While it isn't always true, an interesting approach often results in a good design, as in these twin all-weather stadia designed by Harry Barone and Arnold Horn, Pratt architecture students. Each bowl would be umbrella'd by its own tentlike roof of translucent plastic, hung from the center of soaring arches. Accordion-pleated, these roofs are planned to fold together out of the way in fair weather, their lower edges riding along the rims of the bowls. Cables that guy the arches form a decorative pattern tying the two stadia together. The big football-baseball bowl would hold 65,000 spectators; the smaller, 20,000.

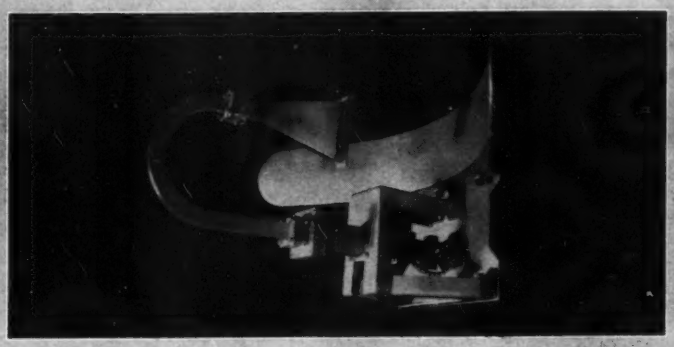
No matter which of today's bright ideas become tomorrow's reality, it will be as important then as it is now to use the best of tools when pencil and paper translate a dream into a project. And then, as now, there will be no finer tool than Mars—from sketch to working drawing.

Mars has long been the standard of professionals. To the famous line of Mars-Technico push-button holders and leads, Mars-Lumograph pencils, and Tradition-Aquarell painting pencils, have recently been added these new products: the Mars Pocket-Technico for field use; the efficient Mars lead sharpener and "Draftsman's" Pencil Sharpener with the adjustable point-length feature; and—last but not least—the Mars-Lumochrom, the new colored *drafting* pencil which offers revolutionary drafting advantages. The fact that it blueprints perfectly is just one of its many important features.

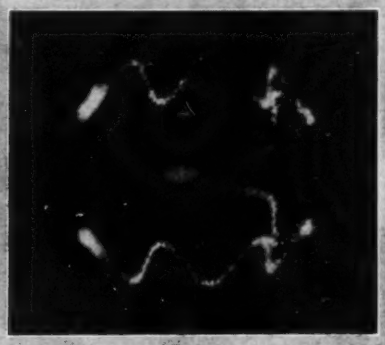
The 2886 Mars-Lumograph drawing pencil, 19 degrees, EXEXB to 9H. The 1001 Mars-Technico push-button lead holder. 1904 Mars-Lumograph imported leads, 18 degrees, EXB to 9H. Mars-Lumochrom colored *drafting* pencil, 24 colors.

J.S. STAEDTLER, INC.
HACKENSACK, NEW JERSEY

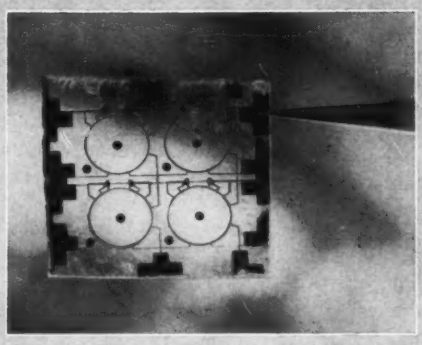
at all good engineering and drawing material suppliers



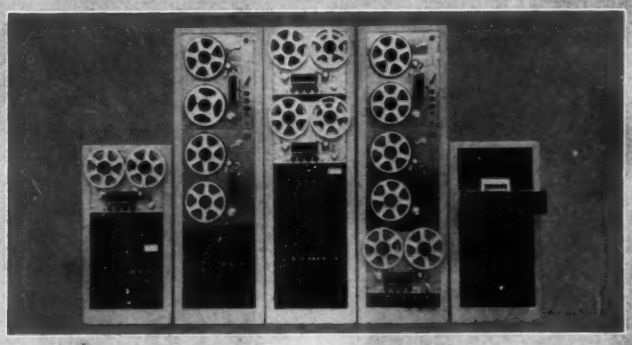
Horn fed parabolic reflector antenna for airborne applications.



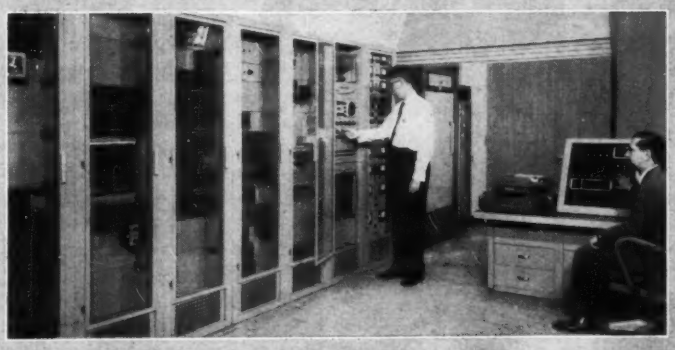
Charged aluminum particle suspended and controlled in a vacuum chamber by an oscillating electric field.



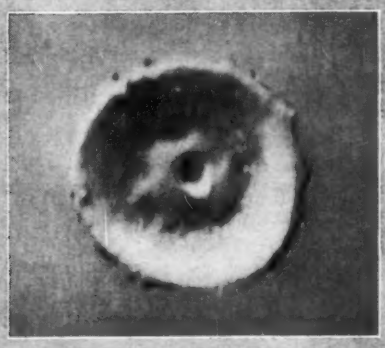
The Persistor gives promise of cryogenic computer memories with a capacity of 1,000,000 bits per cubic foot and access times of 1/30 microsecond.



Ground based data handling equipment for processing analog and digital reconnaissance information.



Data conversion system for digitizing and processing telemetered missile test data.



Electron micrograph of impact produced on aluminum coated glass by a 1 micron diameter particle traveling at 7,000 feet per second.

Pictorial **PROGRESS REPORT**

The photographs above illustrate some of the recent research, development, and manufacturing activities at Ramo-Wooldridge. Work is in progress on a wide variety of projects, and positions are available for scientists and engineers in the following fields:

- Digital Computers and Control Systems
- Communications and Navigation Systems
- Guided Missile Research and Development
- Infrared Systems
- Electronic Countermeasures
- Electronic Instrumentation and Test Equipment
- Basic Electronic and Aeronautical Research

The Ramo-Wooldridge Corporation

LOS ANGELES 45, CALIFORNIA

COLLEGE NEWS

(Continued from Page 29)

DEAN'S LIST, 1957–1958

A weighted average of 85% or better for one year is required for students of the College of Engineering to be placed on the Dean's Honor List.

School of Chemical and Metallurgical Engineering

Philip L. Bereano, Warren W. Bovie, Richard G. Buckles, Lloyd A. Goettler, Harold U. Hammershaimb, Edward J. Kramer, Paul P. Morrison, Samuel W. Bodman III, Harry L. Fuller, Walter C. Gates, Roy J. Lamm, Max C. Deibert, Allen P. Miller, Edward H. Zander, Donald E. Buzzelli, Robert W. Hendricks, Michael Midler Jr., John W. Nestor Jr., David L. Ripps, Jay L. Markley, Albert M. Sacerdote, James V. Tarbell.

School of Civil Engineering

Donald G. Armstrong, David S. Burnett, Stuart C. Edelberg, David S. Fuss, Richard N. Karnes, Gordon L. Kraus, Carl B. Loutzenheiser, James P. Naismith, Robert S. Queener, Martin H. Sahn, Arthur Scheinuk Jr., Richard A. Shigekane, Loring E. Smith, Paul M. Teicholz.

School of Electrical Engineering

George E. Beine, David A. Berkley, William E. Blair, John E. Burget, James B. Comly, Humberto Cordero, Harold D. Craft, Thomas Criswell, Walter R. Curtice, John N. DeRis, Robert Edelman, Richard F. Fellows, Karl A. Foster, Jeffrey I. Frey, J. Arthur Hirsch Jr., Lewis M. Holmes, Joel S. Jayson, Richard L. Kaufman, Keith R. Kleckner, Arthur R. Kraemer, William C. Krell, Robert J. Loane, Karl S. Menger, Abraham J. Osofsky, Thomas A. Phillips, William Quackenbush, John E. Romaine, David P. Snyder, Peter D. Sofman, Robert K. Stoddard, Paul D. Thompson, James S. Thorp, Donald C. Uber, Robert C. Waag, Peter S. Warwick, Richard Weiss, James J. Whalen, Mark P. White, William M. Wichman, John E. Winter, Phillip R. Witt, Peter H. Wolf, David Wunsch.

FIVE NEW PROFESSORS NAMED TO THE ENGINEERING FACULTY

Five new professors are joining the faculty of the College of Engineering this fall term taking teaching and research positions in engineering physics, electrical engineering, chemical engineering and engineering mechanics and materials.

Dr. T. N. Rhodin, an expert in surface physics, particularly oxidation and corrosion, has been appointed an associate professor in engineering physics. He graduated Haverford College in 1942 and earned his M.A. and Ph.D. in physical chemistry by 1946. The intervening years between the completion of his doctorate and joining the staff at Cornell were spent doing research and teaching in the Institute of Metals in Chicago, as a Fellow of the American-Scandinavian Foundation in Stockholm and as a Research Associate for DuPont de Nemours.

The new associate professor in electrical engineering is Dr. Ralph Bolgiano. Cornell is not an unfamiliar school to Professor Bolgiano for he has earned four degrees in electrical engineering here: B.S. in E.E., 1944, B.E.E., 1947, M.E.E., 1949 and his Ph. D. in June 1958. He was elected to Tau Beta Pi, Sigma Xi, Eta Kappa Nu and Quill and Dagger. His major research has been on tropospheric propagation.

The department of Engineering Mechanics and Materials is welcoming two new assistant professors, Dr. James Daily and Dr. Yih-Hsing Pao. Dr. Daily comes to Cornell from the Illinois Institute of Technology where he completed his Ph.D. in June 1958 specializing in experimental stress analysis. Dr. Pao was born in China and earned his B.S. in C.E. at the National Taiwan University in 1952. He has just completed his Ph. D. at Columbia University this year in the field of dynamic elasticity.

Dr. Ferdinand Rodriguez is joining the faculty of the Chemical Engineering school after earning his Ph.D. this year at Cornell. With his knowledge of plastics and rubbers gained doing research for the Signal Corps and while doing graduate work at Cornell, he will supervise the active work of the W. C. Geer Laboratory for Plastics and Rubbers at the school.

ASME HOLDS STUDENT CONFERENCE AT CORNELL

On April eighteenth and nineteenth, Cornell University was host to the Region III Student Conference of the American Society of Mechanical Engineers. About 150 student engineers and faculty members from colleges and universities in Washington, D.C., Delaware, Maryland, New Jersey, Pennsylvania, and western New York attended the conference.

The group first took a bus trip to Milliken Station, a new power station near Ithaca operated by the New York State Electric and Gas Corporation. It was of interest to the student mechanical engineers since it represents some of the most advanced thinking in power station engineering problems. Coal and ash are handled automatically in continuous flow and the plant water supply is demineralized in the purification process.

The main events of the Conference were the two three-hour technical sessions held in Upson Hall. These technical sessions were very similar to the professional technical conferences held in all branches of engineering. Sixteen student engineers representing different colleges in Region III presented papers related to current mechanical engineering research problems. The die casting of brass, the determination of thermal conductivity, the development of the torsion dynamometer, the effects of supersonic flight on airplane bodies, the solar battery, and the gas turbine, were among the subjects discussed in the session.

A formal banquet was held after the first technical session. The final event of the conference was an awards luncheon held on April nineteenth. The Villanova entry was judged the best paper presented at the technical session.

THREE NEW GRADUATE STUDY FELLOWSHIPS ESTABLISHED

Three new fellowships have recently been made available for use in graduate study. Recipients will work toward advanced degrees in the Graduate School.

Two of them, under the direction of the School of Civil Engineering, are for study in the use of bituminous materials and bituminous paving mixtures. The New York State Bituminous Concrete Products Association has established a scholarship amounting to tuition and fees plus a $900 stipend and money for research expenses. The Esso Standard Oil Company had established a fellowship in honor of Herbert T. Spencer, retired chief engineer with the Asphalt Institute, which includes tuition and fees, a $1400 stipend and money for research expenses.

A fellowship for study in the fields of metallurgy, chemistry, physics or mathematics was established by the Carpenter Steel Company. It was set up through the Carpenter Steel Foundation in memory of J. Heber Parker, '05, who was chairman of the company at the time of his death in December, 1956. Harley A. de Wilde, a graduate of St. Martin's College in Washington, has been selected as the first fellow. He is studying chemistry.

WALTER GUNDEL RECEIVES FUERTES SPEECH AWARD

Walter D. Gundel, ME '58, speaking on "Power From the Ocean," won the $100 first place award in the fortieth annual Fuertes Memorial Contest in Public Speaking. The contest finals were held on April 30 in Olin Hall.

Paul Rosenbaum, EE '58, won the $40 second place award for his speech on "The Challenge of Outer Space." Third place went to Thomas Criswell, EE '58, who spoke about "The Problem of Reliability" He received $20.

Other finalists in the contest were Paul Gladstone, ME '58, and Carl Steinitz, Arch '59. Their topics were respectively "A New Look at Engineering Unions and Professionalism" and "Applied Sociology and Mass Housing."

UPSON HALL DEDICATED DURING ALUMNI WEEK

The opening of Upson Hall, and the move of the Sibley School of Mechanical Engineering to its new home, marks the shift of the "center of gravity" of the College of Engineering to the new Engineering Quadrangle. Upson Hall, the largest building on the Engineering quad, is the fifth to be completed. Grumman Hall for Aeronautical Engineering, and the Civil Engineering building, are under construction.

Upson Hall was formally presented to the University on Saturday, June 14, by the donor, Maxwell M. Upson, chairman of the board of Raymond International, Inc. of New York. S. C. Hollister, dean of the College of Engineering, presided at the dedication ceremonies. Deane W. Malott, president of Cornell, accepted the building on behalf of the University. Others participating included Harry J. Loberg, director of the School of Mechanical Engineering, representing the school, and Richard G. Brandenburg, M.E. '58, representing the students.

Upson Hall, which accommodates approximately 700 undergraduates and graduate mechanical engineering students, was finished in April of this year. The building contains approximately 126,000 square feet of floor space. It has two wings—one for classrooms and offices, and one for laboratories and research rooms—with a connecting central utility core.

CORNELL STUDENTS TAKE HONORS IN NATIONAL ESSAY CONTEST

Cornell University students won top honors in a national essay contest dealing with capital equipment acquisition and replacement.

The fourth annual competition was sponsored by the National Center of Education and Research in Equipment Policy at Illinois Institute of Technology, Chicago.

Salah A. Elmaghraby, Cairo, Egypt, was awarded $600 in the graduate division for his first place essay.

Honorable mention on the graduate level was awarded to Souren Hanessian, Washington, D.C., who received $200 for his paper titled "Equipment Replacement."

The equipment policy center was established at Illinois Tech in 1953 in cooperation with the Machinery and Allied Products Institute and the Council for Technological Advancement.

REHKUGLER WINS "MATERIALS HANDLING CONTEST" PRIZE

Gerald Rehkugler, a graduate student in agricultural engineering, has been awarded first prize of $125 in the Silent Hoist and Crane Company Materials Handling Contest at Cornell.

Rehkugler received the prize for his paper titled "A Practical and Theoretical Analysis of the Performance of Inclined Screw Conveyors." The annual award, provided by the Silent Hoist and Crane Company, Brooklyn, N.Y., is for the best paper on the topic of materials handling.

Rehkugler's paper described an experimental and mathematical analysis of the operating characteristics of screw conveyors as used in transporting bulk materials between elevators.

CORNELL RECEIVES AEC GRANT FOR METALLURGY RESEARCH

A $12,850 grant by the U.S. Atomic Energy Commission to Cornell University for renewal of a metallurgy research contract may determine more of the characteristics of the surface that exists where liquid meets solid.

The research program, formally titled "Liquid-Solid Interfacial Tensions in Metal Alloy System," is being conducted by Associate Professor Chester W. Spencer of the School of Metallurgical and Chemical Engineering and members of his staff. Professor Spencer states that the research itself is fundamental and any application to practical use will be made by one of the national laboratories such as Brookhaven, Oak Ridge or Argonne.

The researchers hope to learn more about the rate and type of penetration that certain liquids make between crystals at the surface of a metal. Eventually the results may be useful in construction of nuclear reactors, brazing and soldering of metals and the manufacture of metals with better high-temperature and anti-corrosive properties.

BOOK REVIEW

A FRESH LOOK AT CHEMISTRY

CHEMISTRY, Michell J. Sienko and Robert A. Plane, McGraw-Hill Book Co., New York, Toronto, London, 1957. Reviewed by L. E. Conroy.

Time was when a freshman General Chemistry textbook was essentially a compilation of information about the nature of the chemical elements and their compounds. In order to make systematic the description of so many species of such diverse natures the presentation was organized on the basis of the periodic table of the chemical elements. Unfortunately, this approach tended to create in the mind of the student the impression that chemistry was devoted almost wholly to the description and classification of experimental phenomena. Such an impression is inaccurate from at least two standpoints. First, it does not reflect the true status of chemistry as a science. The description phase and classification phase are the early ones in the process of development of any science. Early in this century, chemistry entered the phase where the emphasis is upon understanding and explaining the experimental phenomena which have been studied and recorded.

Secondly, to treat chemistry as merely a body of information is to confine it intellectually in a too pragmatic status. Chemistry is a *liberal* study. The study of chemistry is included in a liberal arts curriculum because, (1) it can contribute to the understanding of our physical environment and life processes, and (2) the methods of reasoning and investigation used are intellectual enterprises of a high order. In an engineering curriculum, chemistry has the additional importance of providing one of the fundamental physical science bases for the applied sciences.

In recent years, general chemistry texts have begun to emphasize the physical principles underlying the behavior of matter. In this respect, the introductory chemistry course has, in part, taken on the aspect of an elementary physical chemistry course, wherein the principles of physics are applied to chemical problems. The properties of the chemical elements and their compounds continue to hold an important place in the modern texts, but an effort is made to explain the properties using the physical principles which have been discussed earlier. The general effect, then, is to present chemistry as a body of knowledge unified and made reasonable by the governing laws of physics.

CHEMISTRY by Professors Si-

Michell J. Sienko R. Epstein

PROFESSOR SIENKO

After his graduation from Cornell in 1943, Dr. Sienko went to the University of California in Berkeley to work for his doctorate. He was awarded his degree in February of 1946. His next move was to Stanford University at Palo Alto, California, to work for the Office of Naval Research.

In 1947, Dr. Sienko returned to Cornell. He was appointed assistant professor in 1950, began teaching Chemistry 105 and 106 in the fall of 1951, and in 1953 was appointed associate professor, a welcome addition to one of the country's finest staffs.

His philosophy of teaching and methods of preparation reflect the common sense attitude that has given him his reputation. An average of five hours is spent preparing for every one-hour lecture. Seldom does he allow himself the luxury of reference to any written material whether in the form of books or the lecture notes of the year before. He claims that asking the student to remember what he cannot himself recall is unethical.

PROFESSOR PLANE

Dr. Plane received his AB degree from Evansville College in 1948 and his PhD from the University of Chicago in 1951. He worked as a research chemist at Oak Ridge for one year, and came to Cornell in 1952.

Professor Sienko and he believe that the most important things to be learned in that course are a way of thinking and a method of approach. He realizes that most of his students are not going to be chemists, and that this way of thinking is more important to them than the ability to solve problems.

Dr. Plane feels that the average student will learn about seventy per cent of the material presented whether the course is difficult or "watered down." He, therefore, tries to make his course challenging and interesting for the student.

Robert A. Plane R. Epstein

enko and Plane is an outstanding example of the "new" approach to the presentation of general chemistry. The first half of the book is entitled "Principles of Chemistry" and includes Nature of Matter, Atoms, Chemical Bond, Changes of State, Chemical Kinetics, and Chemical Equilibrium among its chapters.

The chapter on Chemical Kinetics is particularly fine, and it exemplifies one of the most refreshing qualities of the authors' approach. That quality is the characterization of chemistry as a living, growing science which is still seeking answers to questions about the behavior of matter. It is made clear that our knowledge of the detailed mechanisms by which chemical processes occur is highly imperfect; that there is still ample opportunity for original thought and experiment to contribute to our understanding. Throughout the book many of the unanswered questions of chemistry are posed. Never is the subject presented as dogma, and differing viewpoints on particular topics are often offered.

Perhaps the best aspect of this text is that it it written to *teach*. Professors Sienko and Plane based their book upon tape recordings of their actual lectures as delivered to classes at Cornell. The lecture approach emerges throughout the volume. All too many chemistry texts seem to be written to impress other chemists with the author's erudition. This one obviously had the student in mind.

As for the book in practice, the reviewer is now using CHEMISTRY as a text in his freshman general chemistry class. The students seem to like it just fine.

About the Reviewer

Dr. Lawrence E. Conroy is a native of Rhode Island. He received a B.S. from the University of Rhode Island in 1949 and a Ph.D. from Cornell in 1955. He has industrial experience as a physical chemist, studying the properties of liquid films. He is now Assistant Professor of Chemistry at Temple University in Philadelphia, where he teaches freshman chemistry and advanced inorganic chemistry and directs some research on solid state chemistry.

Allis-Chalmers offers training course

In nucleonics, Andrew Selep, Brooklyn Polytechnic Institute, BME '53, is working on the problem of reactor safeguards.

Special engineering by Paul W. Clark, Iowa State College, EE '49, is of large job involving combined electrical equipment.

Sales manager, Robert Horn, Marquette University, EE '51, heads sales of voltage regulators used on power lines.

Electronics man, William E. Martin, Alabama Polytechnic Institute, BSEE '53, engineers applications of induction heaters.

plus wide choice of type and fields of

Design of generators for steam turbines is directed by G. W. Staats, Illinois Institute of Technology, Ph. D. '56.

Field sales of America's widest range of industrial equipment is career of Carl E. Hellerich, U. of Nebraska, ME '49.

Promotion man, Robert I. Carlson, Worcester Polytechnic Institute, ME '50, directs promotion of switchgear, and substations.

Application and sales of steam condensers for power plants are handled by William E. Ellingen, U. of Wisconsin, ChE '49.

work on equipment for many industries

THE outstanding training course started by Allis-Chalmers has proved a springboard to many worthwhile careers In fact, most of the A-C management team has stemmed from its ranks.

Up to two years of theoretical and practical training are offered. This experience leads to jobs in research, design, manufacturing, application and sales.

Even though you may not know exactly what you wish to do, the Allis-Chalmers training course is designed to help you find the type of work and the field to which you are best suited.

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Each day the engineers pictured below solve problems involved in energy conversion, transmission, distribution and application of power for the expanding American Electric Power System.

These engineers are representative of over 800 who work in eight states on the stimulating and challenging problems faced by our growing system.

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American Electric Power Service Corporation, 30 Church Street, New York 8, N. Y. • Ohio Power Company, 301-315 Cleveland Avenue, S.W., Canton 2, Ohio • Indiana & Michigan Electric Company, 2101 Spy Run Avenue, Fort Wayne 1, Indiana • Kentucky Power Company, 15th Street and Carter Avenue, Ashland, Kentucky • Wheeling Electric Company, Wheeling, West Virginia • Appalachian Power Company, 40 Franklin Road, Roanoke 9, Virginia

AMERICAN ELECTRIC POWER SYSTEM

(Formerly American Gas and Electric System)

1. Pikeville, Kentucky—ENGINEERING SECTION HEAD
William W. Zoellers (Univ. Ky., BSEE '51) adjusts step-voltage regulator serving an important industrial customer.

2. New York City—PLANNING SYSTEM EXPANSION
James E. Beehler (Purdue, MSEE '48), Frank W. Clover (Carnegie Tech, BSEE '47; Harvard, MA '51), Richard E. Disbrow (Lehigh, BSEE '52), plan the AEP System of the future with a network analyzer.

3. New York City—STAFF ENGINEERS
Richard H. Pechstein (RPI, BME '46) and John E. Dolan (Columbia, BSME '50) perform heat balance calculations on new steam cycle.

4. Wheeling, W. Va.—DISTRIBUTION ENGINEERING
Enea Antonucci (West Virginia, AB, BSEE '54) and Robert O. Meador (Tri-State, BSEE '49) supervise installation of underground distribution facilities.

5. New York City—NUCLEAR POWER ENGINEERS
John R. Struyk (Clarkson, BME '51) and Robert S. Hunter (Penn State, BSME '50) discuss design of fuel element.

6. New York City—APPLYING DIGITAL COMPUTERS
Howard K. Amchin (Penn State, BSEE, '46; IIT, MSEE '49) and Glenn Stagg (MIT, BSEE '48; NYU, MBA '56) selected by Eta Kappa Nu as one of three outstanding young engineers in the U. S. in 1958, solve a special problem faced by the AEP System.

7. Roanoke, Virginia — INDUSTRIAL POWER ENGINEER
Robey Jarrett (VPI, BSEE '51) consults with contractor on progress of motel to be heated and cooled electrically.

8. Canton, Ohio—SYSTEM OPERATION ENGINEER
Richard P. Blaes (Dayton, BEE, '51) helps to coordinate load scheduling and exchange of power with other electric utilities.

9. Twin Branch, Indiana—POWER PLANT MAINTENANCE SUPERVISOR
Herbert A. Bissinger (Michigan College of Mining and Technology, BSEE '50) leads briefing session concerning turbine overhaul schedule.

10. East Liverpool, Ohio—DISTRICT MANAGER
William A. Black (MIT, SMEE '50) discusses operating problem with the supervisors on his staff.

11. New York City—RESULTS ANALYSIS
Engineering trainee Paul Butler (Purdue, BSME '58) discusses features of recording instrument with steam generation engineer Richard C. Kopelow (Michigan, BSME '51).

12. New Haven, West Virginia—RESULTS ENGINEER
William R. Johnston (Univ. of Cincinnati, BSME '51) analyzes circuit for electronic instruments at a major power plant.

13. Muncie, Indiana—DIVISION METER SUPERVISOR
Jack Stark (Purdue, BSEE '49) examines the demand chart on a metering device for an industrial customer.

14. New York City—HIGH VOLTAGE RESEARCH
Jack M. Miller (Milwaukee, BSEE '57) and Robert H. Schlomann (MIT, SMEE '56) discuss means for reducing radio influence on 345 kv transmission lines.

TECHNIBRIEFS

(Continued from Page 57)

miniature microphone in the special earpiece to create a second noise—just as loud, but opposite in phase. When the two sound waves meet in the earcup, they use up almost all their energy fighting each other, thereby greatly reducing the noise level. As a result a loud roar is muffled to a whisper.

In combat, the earphones might be used by artillerymen to protect their eardrums and improve communications or could increase the efficiency of sonar operators by eliminating distracting noises. They might also quiet high noise levels for jet bomber and ground maintenance crews.

The earpieces work in conjunction with a special electronic inverter and amplifier unit that in large scale production could be made small enough to fit into a soldier's pocket. The electronic system cuts low pitched sounds down to as little as 1/10th their original volume. Higher pitched sounds are trapped by special foam cushioning.

NEW METHOD OF RECORDING SPRING WIRE TORQUE VALUES

The National Bureau of Standards has been investigating the effect of metallurgical variables on the properties of spring wire. Because the wire from which helical extension or compression springs is wound is stressed in torsion, a means was sought for measuring the torsional properties easily and accurately. Consequently, an apparatus was constructed that automatically records the torque-twist characteristics of wire less than 0.05 inches in diameter.

Designed by H. C. Burnett and J. A. Bennett of the mechanical metallurgy laboratory, the equipment provides a rapid, easy method for determining the torsional properties of small-diameter wire. The spark recording system utilized is entirely frictionless so that even small torque values can be recorded accurately. The apparatus should be of general utility in developing more significant specifications for the spring wire used in many types of ordnance items.

ALCHEMY

(Continued from Page 23)

chemist, may evaluate it from a look at the knowledge of processes and equipment it contributed to the sciences. A fair appraisal must include both these views and many others. True, many professed alchemists were merely imposters, but they were not true alchemists, merely an unfortunate by-product.

The real value of the art lay in its many contributions to the sciences —in equipment and processes and also in development of a scientific approach to problems of nature. This last contribution did not come until the end of alchemy, but without the developments up to that time, so-called "scientific approach and attitude" could not have been produced. Indeed, the search of the adepts for the "great truth"—the Philosopher's Stone, the Elixir of Life, and the means of obtaining transmutation—is much like our present day search for the "universal law"—the basic formula relating all natural phenomena.

BRAIN WAVES

(Continued from Page 46)

may be grounded, since the spurious signals that would be picked up with grounding, would swamp out the desired brain voltage variations. Pushpull circuits are therefore mandatory.

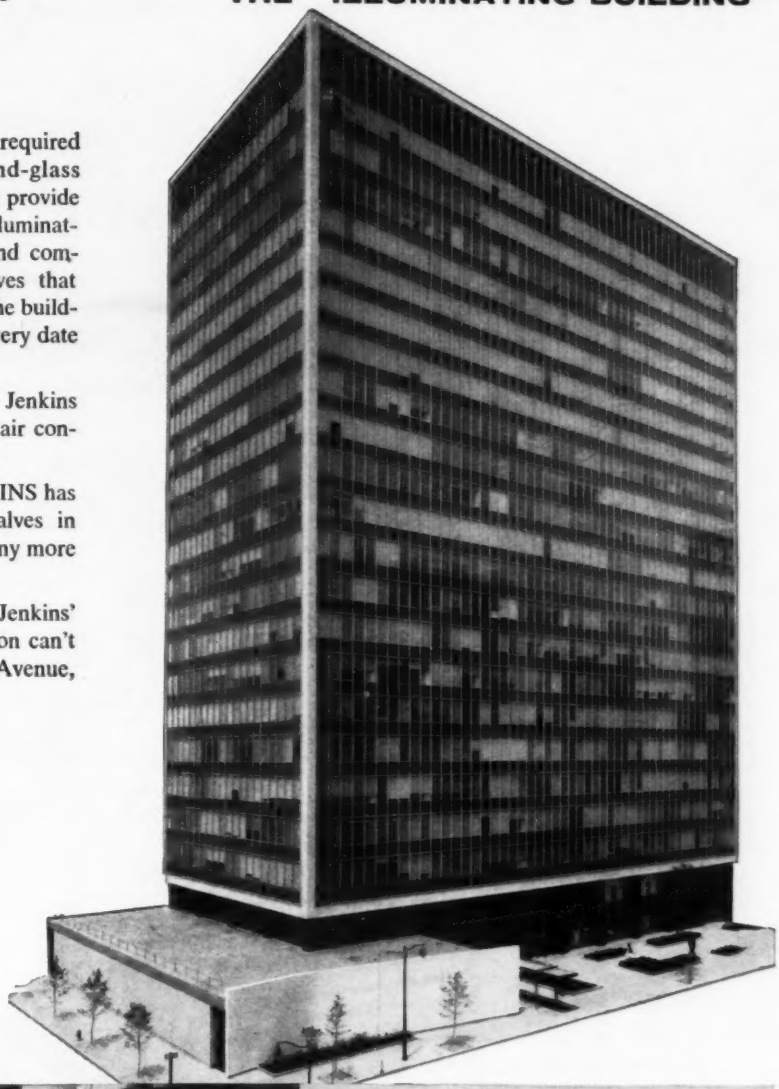
To summarize then, brain-waves are the time varying potentials generated on the surface of the scalp by nerve cell populations associated with brain activity. They have physiological significance and will undoubtedly attain a higher status in both physiology and psychology as clinical interpretations become more accurate.

Towards this end of attaining more accurate interpretations, analysis of EEG's has been switched from Fourier wave decomposition to Gram-Charlier Series. This is a series of statistical distribution functions which has a direct biophysical basis, and therefore promises to permit extraction of more information from the EEG than has been possible up to the present time.

New Beauty on Cleveland's Skyline

Got lifetime service valves and got them fast by choosing JENKINS

THE ILLUMINATING BUILDING



More than top quality in valves was required for this $17,000,000 aluminum-and-glass building, completed in April 1958 to provide offices for the Cleveland Electric Illuminating Company and other industrial and commercial tenants. In addition to valves that would last for the building's lifetime, the builders sought assurance that a close delivery date would be met.

Both were assured by the choice of Jenkins Valves for all plumbing, heating and air conditioning lines.

For almost a century the name JENKINS has meant enduring quality. Jenkins Valves in service for fifty years and good for many more are often reported.

And, when valves are needed quickly, Jenkins' efficient, national system of distribution can't be surpassed. Jenkins Bros., 100 Park Avenue, New York 17.

Architects:
Carson and Lundin, New York

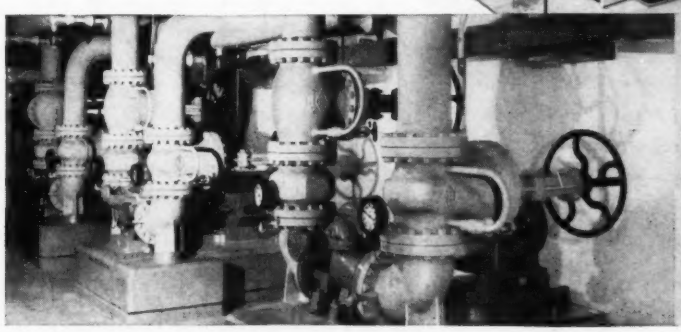
Consulting Engineers:
Jaros, Baum & Bolles, New York;
McGeorge, Hargett and Associates, Cleveland

General Contractor:
George A. Fuller Company, New York

Heating-Air Conditioning Contractors:
Kerby Saunders Company, New York;
Feldman Brothers Company, Cleveland

Plumbing Contractors:
Kerby Saunders Company, New York;
Gorman Lavelle Plumbing-Heating Co., Cleveland

Managing Agents:
Ostendorf-Morris Company, Cleveland



Typical of more than 4,000 Jenkins Valves of bronze, iron and cast steel serving this building owned by the 55 Public Square Corp., Cleveland.

JENKINS
LOOK FOR THE JENKINS DIAMOND
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JENKINS SINCE 1864
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STRESS *and* STRAIN . . .

A minister and his wife were talking about two of the members of his congregation.

"Yes," said the minister, "I knew both of them as boys. One was a clever, handsome fellow and the other a steady hard-worker. The clever one was left behind in the race, but the hard worker, well, he died and left $200,000 to his widow. There's a great moral to this story."

"Yes," smiled his wife, "there certainly is. I heard today that the clever one is going to marry the widow."

• • •

Bank President: "I like the way you handle money. Where did you learn?"

Teller: "In Yale."

Bank President: "And what is your name, son?"

Teller: "Yohnson."

• • •

The old man was really mad as he called his sons in and demanded to know which one had pushed the privy in the river.

"I did, Pa," Zeke spoke up.

"Come out to the woodshed, boy. I'm going to whale the daylights out of you."

"George Washington's father didn't punish him when he told the truth," pleaded Zeke.

"That's right," replied the old man, "but George Washington's Pa wasn't sitting in the cherry tree."

• • •

The football soared through the air and fell into the barnyard, right at the rooster's feet. A look of wonder came into his eyes as he surveyed it from all sides. Then he gracefully pushed the ball into the henhouse and faced his harem.

"I'm not complaining, ladies," he said, "but I just want you to see for yourselves the work that is being done in the other yard."

• • •

A car pulled up along side a couple seated in a car.

"What's the matter," asked the intended helper, "out of gas?"

"Nope," came the answer from the inside.

"Engine trouble?"

"Nope."

"Tire down?"

"Didn't have to."

• • •

The squad of marines had been out to the rifle range for their first try at marksmanship. They knelt at 250 yards and fired. Not a hit. They moved up to 200 yards and tried again. Not a hit. They tried at 100 yards. Not a hit.

"Tenshun!" the sergeant drawled. "Fix bayonets! Charge! It's your only chance."

• • •

The lumber camp foreman put a newly hired graduate to work beside a whizzing circular saw. As he started to walk away, he heard an "ouch!" and turned to see the graduate looking puzzledly at the stump of a finger. Rushing back, he asked what happened.

"I dunno," said the boy. "I stuck my hand out like this and . . . well I'll be damned, there goes another one."

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A persuasive Texas real estate man had just finished a glowing description of the opportunities to be found in West Texas to a prospect from Chicago. "All West Texas needs," said the realtor, "to become the garden spot of the world is good people and water."

"Huh," replied the prospect: "That's all Hell needs."

"Tree Rubber" made in U.S.A. for tires of tomorrow

Photography and x-rays pointed the way for Goodrich-Gulf Chemicals Inc. to achieve a synthetic that matches natural rubber.

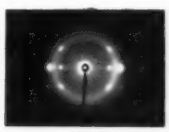
Heavy-duty truck and airplane tires always had to have tree rubber to assure acceptable performance. Usual man-made rubber didn't quite fill the bill. Its molecules didn't hang together like natural rubber.

But now Goodrich-Gulf scientists, using x-ray diffraction photographs to check molecular structure, have produced Ameripol SN, a man-made rubber with the same physical properties as crude rubber even to tack and stickiness. It's an achievement that can mean a source of supply for the nation's new-rubber needs.

Playing a part in research like this is only one of the many ways photography is working for business and industry today. In addition, it also delves into problems of product design, production, and quality control. It trains employees, dealers and salesmen—does a selling job right to the consumer.

Photography is saving time and cutting costs for all kinds of businesses, large and small alike. It works for you in whatever occupation you choose.

Photographic negative showing the x-ray diffraction pattern produced by a molecule of natural, tree-grown rubber.



The x-ray diffraction pattern of a molecule of Ameripol SN rubber shows the scientist that this rubber is identical to natural rubber.

EASTMAN KODAK COMPANY, Rochester 4, N. Y.

CAREERS WITH KODAK

With photography and photographic processes becoming increasingly important in the business and industry of tomorrow, there are new and challenging opportunities at Kodak in research, engineering, electronics, design and production.

If you are looking for such an interesting opportunity, write for information about careers with Kodak. Address: Business and Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N. Y.

Kodak
TRADE MARK

One of a series*

Interview with General Electric's Earl G. Abbott Manager—Sales Training

Advancement in a Large Company: How it Works

Where do you find better advancement opportunities—in a large company or a small one? To help you, the college student, resolve that problem, Mr. Abbott answers the following questions concerning advancement opportunities in engineering, manufacturing and technical marketing at General Electric.

Q. In a large Company such as General Electric, how can you assure that every man deserving of recognition will get it? Don't some capable people become lost?

A. No, they don't. And it's because of the way G.E. has been organized. By decentralizing into more than a hundred smaller operating departments, we've been able to pinpoint both authority and responsibility. Our products are engineered, manufactured and marketed by many departments comparable to small companies. Since each is completely responsible for its success and profitability, each individual within the department has a defined share of that responsibility. Therefore, outstanding performance is readily recognized.

Q. If that's the case, are opportunities for advancement limited to openings within the department?

A. Not at all. That's one of the advantages of our decentralized organization. It creates small operations that individuals can "get their arms around", and still reserves and enhances the inherent advantages of a large company. Widely diverse opportunities and promotions are available on a Company-wide basis.

Q. But how does a department find the best man, Company-wide?

A. We've developed personnel registers to assure that the best qualified men for the job are not overlooked. The registers contain complete appraisals of professional employees. They enable a manager to make a thorough and objective search of the entire General Electric Company and come up with the man best qualified for the job.

Q. How do advancement opportunities for technical graduates stack-up with those of other graduates?

A. Very well. General Electric is recognized as a Company with outstanding technical skills and facilities. One out of every thirteen employees is a scientist or engineer. And approximately 50 per cent of our Department General Managers have technical backgrounds.

Q. How about speed of advancement? Is G.E. a "young man's Company"?

A. Definitely. A majority of all supervisors, managers and outstanding individual contributors working in the engineering function are below the age of forty. We believe that a job should be one for which you are qualified, but above all it should be one that challenges your ability. As you master one job we feel that consideration should be given to moving you to a position of greater responsibility. This is working, for in the professional field, one out of four of our people are in positions of greater responsibility today than they were a year ago.

Q. Some men want to remain in a specialized technical job rather than go into managerial work. How does this affect their advancement?

A. At G.E. there are many paths which lead to higher positions of recognition and prestige. Every man is essentially free to select the course which best fits both his abilities and interests. Furthermore, he may modify that course if his interests change as his career progresses. Along any of these paths he may advance within the Company to very high levels of recognition and salary.

Q. What aids to advancement does General Electric provide?

A. We believe that it's just sound business policy to provide a stimulating climate for personal development. As the individual develops, through his own efforts, the Company benefits from his contributions. General Electric has done much to provide the right kind of opportunity for its employees. Outstanding college graduates are given graduate study aid through the G-E Honors Program and Tuition Refund Program. Technical graduates entering the Engineering, Manufacturing, or Technical Marketing Programs start with on-the-job training and related study as preparation for more responsible positions. Throughout their G-E careers they receive frequent appraisals as a guide for self development. Company-conducted courses are offered again at all levels of the organization. These help professionals gain the increasingly higher levels of education demanded by the complexities of modern business. Our goal is to see every man advance to the full limits of his capabilities.

If you have other questions or want information on our programs for technical graduates, write to E. G. Abbott, Section 959-9, General Electric Co., Schenectady 5, N. Y.

***LOOK FOR other interviews discussing: • Qualities We Look For in Young Engineers • Personal Development • Salary.**

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